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United States Naval Institute Proceedings

VOL. 51 MAY, 1925 NO. 267

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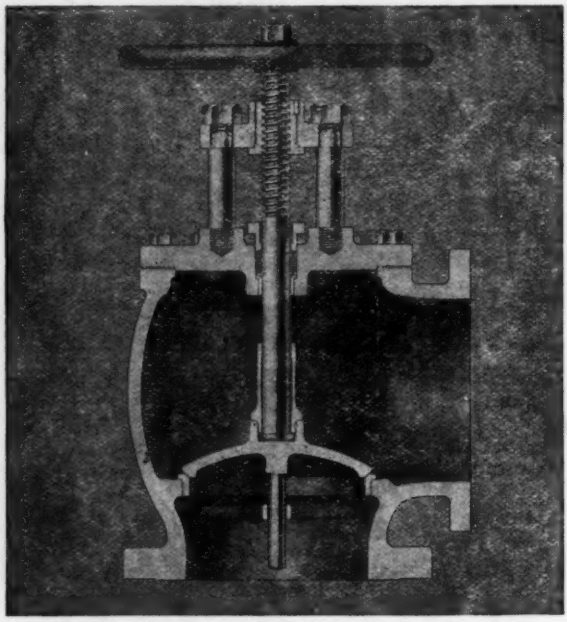

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United States Naval Institute Proceedings

May, 1925

Edited by H. A. Baldridge

U. S. Naval Institute

Publication Office: Menasha, Wisconsin

Editorial and Business Office: Annapolis, Maryland

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The Collegiate Press
GEORGE BANTA PUBLISHING CO.
MENASHA, WIS.

UNITED STATES NAVAL INSTITUTE
PROCEEDINGS

VOL. NO. 51, NO. 5 MAY, 1925 WHOLE NO. 267

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Editor, Captain H. A. Baldridge; Assistant Editor, Lieutenant Commander Roy C. Smith, Jr.

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Published monthly at 450 Ahnaip St., Menasha, Wis.

Executive, Editorial, and Business Offices, U. S. Naval Institute, Annapolis, Md.

Entered as second-class matter at the post-office at Menasha, Wis., April 4, 1922, and at the post-office at Annapolis, Md., under Act of Aug. 24, 1912. Acceptance for mailing at the special rate of postage provided for in section 1103, Act of Oct. 3, 1919, authorized Mar. 13, 1922.

Membership dues (including Proceedings), $3.00 a year.

Subscription Rates, $5.00 a year. (Foreign postage extra.) Single copies, 50c.

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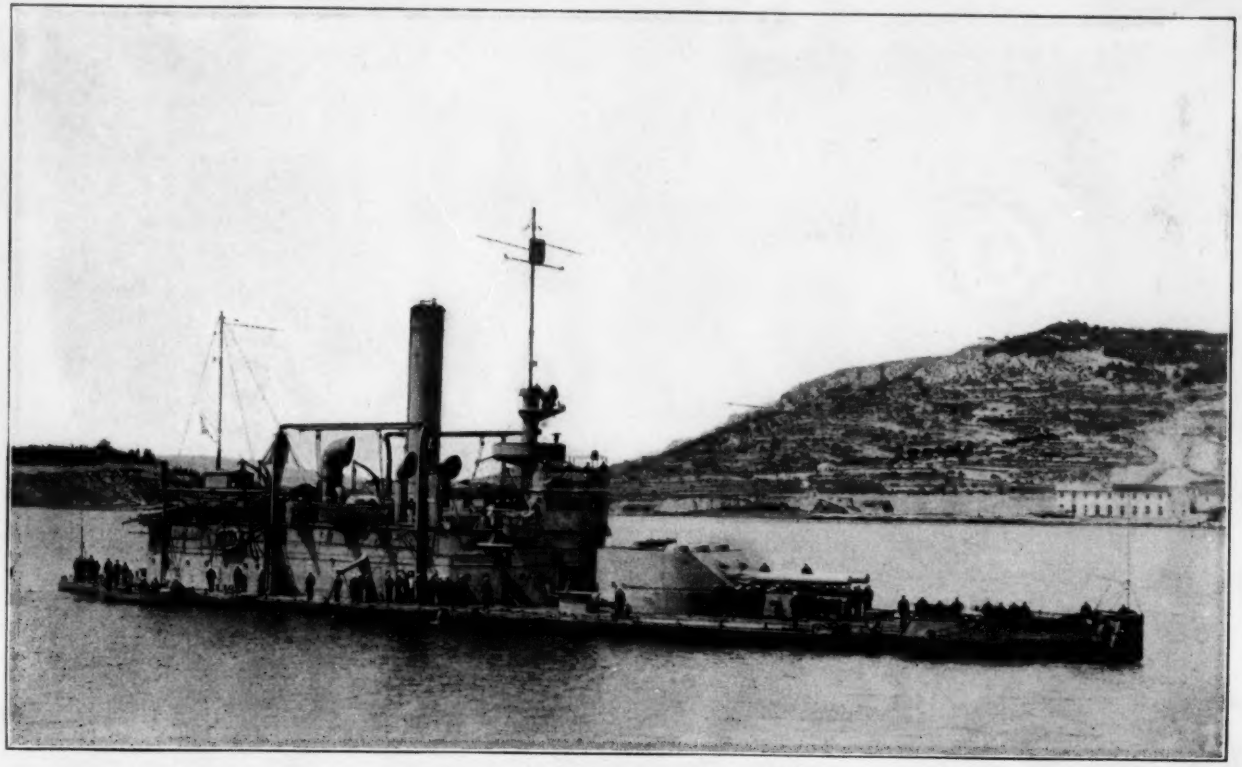

U. S. S. "TONOPAH" AT SPALATO

An Adriatic pilot, sent to meet the monitor, exclaimed, when he saw her, "I am too late. She is sinking!"

UNITED STATES NAVAL INSTITUTE PROCEEDINGS

VOL. NO. 51, NO. 5 MAY, 1925 WHOLE NO. 267

First Honorable Mention, 1925

HISTORY REPEATS

or

THE APPLICATION OF LESSONS OF HISTORY ON A NATIONAL PROBLEM OF TODAY

BY LIEUTENANT COMMANDER O. C. BADGER, U. S. NAVY

MOTTO: Ideas are like coins, those of the least value always have the greatest circulation.—*Punch.*

"THE battleship is doomed!" cries the press of 1924. "It represents a useless expenditure of the taxpayer's money! It can be destroyed by a midget—an airplane! Airplanes have flown around the world, they can sweep the seas of enemy surface craft! Relegate the dreadnaught to the scrap pile!"

These and many similar slogans published today are accepted as new and original ideas. Students of naval history and development, however, know that they are but echoes of the press, oftentimes repeated in years gone by.

"The battleship is doomed!" cried the press of 1870. "It represents a useless expenditure of public funds! It can be destroyed by a midget—a torpedo boat! Torpedo boats have successfully weathered the tempests of the open sea, they can sweep the ocean of the ironclad! Relegate the battleship to the scrap pile!"

U. S. S. "TONOPAH" AT SPALATO

An Adriatic pilot, sent to meet the monitor, exclaimed, when he saw her, "I am too late. She is sinking!"

The similarity of these expressions broadcast fifty years apart was brought about by a similarity of causes. In both cases they resulted from the introduction of a new and important weapon of warfare; in the earlier case, the torpedo, and in the present case, the airplane.

At the time of the invention of the torpedo, Great Britain and France maintained the most powerful navies of the world. This invention, however, brought about the adoption of naval policies and building programs by these two nations, widely different in character. In this fact we are presented with an interesting and important study. History records that the naval policy adopted by Great Britain at that time resulted in her maintenance of unquestioned supremacy of the seas. On the other hand, the faltering policy adopted by France resulted in a serious loss of naval prestige which has never been recovered by that nation.

Looking backward, as we are, through fifty years of development, it is difficult to think of the torpedo as ever presenting a naval threat equivalent to that of the airplane. At the present time, disaster resulting from a torpedo attack launched against a well-organized and well-balanced fleet is considered remote.

But in 1875 there were no vessels built with numerous compartments or bulkheads for underwater protection and stability. One torpedo hit meant destruction. There were no destroyers or vessels fitted to provide anti-torpedo protection for heavy ships. Torpedo boats could approach and attack without fear of being opposed by other than the guns of the ironclad. This meant practically no opposition because there were no suitable guns available. It was a good gun that could fire a projectile 2,500 yards, and, as all guns were muzzle loaders, a rate of fire greater than one shot every two minutes was exceptional. Furthermore, guns that could be trained in azimuth, called pivot guns, were few and far between, often making it necessary to turn the ship itself with the rudder to aim most of her battery.

The developments carried on through the years have overcome these difficulties to a great extent. No longer can unsupported torpedo boats approach the fleet with more than a slight chance of success. Such craft maintain a place of relative importance, but a subordinate one in the organization of the Navy.

In the '70's the navy of France was second only to that of Great Britain. The French treasury was depleted as a result of

the disastrous Franco-Prussian War. The advent of the torpedo was therefore hailed by many Frenchmen as an inexpensive means of reducing the naval supremacy of Great Britain. The press of France, fed by a few able journalists, took up this question with great vehemence and enthusiasm. Public opinion was affected adversely to the ironclad and in favor of the torpedo-craft. The building and maintenance of ironclads were neglected in the sweep of national interest in the promise of the new weapon. The warnings of a conservative element were given but little attention. The battleship, to the public mind, was doomed; it was useless.

Due to the condition of the French treasury, it was only natural that any scheme, claiming low cost, would have a strong appeal to the people. The exponents of the torpedo handled the situation cleverly by speaking of cost only in comparative terms of one torpedo boat against one battleship. The readers of the day were given no figures on the comparatively short life of the torpedo boat and need of more frequent replacement. They were not given sufficient information to judge for themselves as to the greatly increased number of torpedo boat units required. Tenders, supply ships and defensive torpedo boats were spoken of as though they could be acquired at no additional expense.

France had her strategists of the press who proposed new schemes for waging war that were convincing to the layman not familiar with the facts. As is always the case in such circumstances, some division of opinion existed among naval officers, and this was seized upon by the propagandists to strengthen their case. Opposition of naval men, who faced the responsibility of protecting the nation in time of war, was of no avail. Such opposition was met with exaggerated reports of the prowess of the torpedo boats, largely based on the false supposition that the enemy could offer no defense against them.

During the period of evolution of the torpedo, the leader of those enthusiastic as to its future effect on naval warfare was M. G. Charmes. A young journalist of considerable ability, M. Charmes possessed sufficient knowledge of the navy to write convincingly on the subject. His actual naval experience was limited, but what he lacked in experience was compensated for by vivid imagination and ability with the pen. The great national dailies and periodicals, including *le Temps, Revue Politique et Litteraire,*

Journal des Debats, and the *Revue des deux Mondes,* accepted and published his articles, giving them wide circulation. These writings were summed up in two books, entitled *Torpilleurs Autonomes* and the *Reforme de la Marine.*

Due to their usual reluctance to engage in such controversy and to the restrictions regarding writing for publication, naval officers of the day offered little public opposition to M. Charmes and his adherents. The latter, however, were not unopposed in the journalistic field, considerable publicity being given to men less extreme in their ideas. Of these, M. Weyl and Vice Admiral Bouchois, French Navy, may be considered the most able. With many years of naval service to their credit, these men possessed a thorough working knowledge of the navy, conditions at sea, and the naval requirements of an important war. They protested against the destruction or deterioration of the French ironclads and fought the acceptance, on the part of France, of the torpedo boat as more than an important arm of the naval service.

Today, in the United States, we have a repetition of history. The sentiment in this country decidedly favors any scheme purporting to reduce the cost of national defense. We have our strategists of the press, our exaggerations of the power of the airplane, our claims for its invulnerability in the face of proposed means of defense. In fact, so parallel are the two cases that the articles and publications of 1870 require the changing of only three words to make them applicable to the present controversy.

The substitutions of the words "airplane" for "torpedo boat," "battleship" for "ironclad," and "airplane carrier" for "transport" in the writing of M. Charmes, M. Weyl and their contemporaries make them easily recognizable to readers of today, as shown by a few examples following:

> The torpedo (airplane) will surely triumph over the ironclad (battleship) and modern fleets will be consigned to the Naval Museum of the Louvre by the revolution that torpedo (airplane) warfare will bring about. Unquestionably, armor has been vanquished not by the gun but by the torpedo (airplane).

Speaking of a conservative program of naval construction, M. Charmes further states:

> As a result of all this, the man-of-war inclined to become more and more a gigantic mass of iron and steel, all but invulnerable, armed with

gigantic artillery, possessing the greatest possible power of penetration, machines of enormous weight, a complication of numberless mechanisms, a very miracle of construction, but with the double disadvantage of costing at least some fifteen millions. . . . . As often happens in human affairs, a grain of sand was the means of arresting the naval giant and now threatens it with speedy death. The appearance of torpedoes (airplanes) etc. . . . .

The Prince de Joinville, a contemporary of M. Charmes, writes:

At present there exists no means of defense against the torpedo (airplane). In the first war it will threaten both big and little ships in every direction. A well-placed ton of powder will suffice to send the whole naval force to the bottom, with all the millions represented, including the hundreds of human beings who man them.

Reverting to several comments of M. Charmes, the close relation between the claims of the French enthusiasts and those of the airplane proponents is clearly shown.

In dealing a mortal blow to the ironclad (battleship) the advent of the automobile torpedo (airplane) at once puts an end to the race which has, for some years, gone on between the ironclad (battleship) and its guns. . . . .

The Minister of Marine has set down in his pamphlet, that a sum of 130 millions is required to complete the fourteen ironclads (battleships) now on the stocks. Take fourteen millions off this sum for transports (airplane carriers) and 116 millions would remain with which we might construct the best fleet of torpedo vessels (airplanes) in the world. It would consist of forty-five defensive torpedo boats (fighting planes) and 200 torpedo boats (bombing planes). With such a fleet we would be irresistible on the Mediterranean and invincible on the ocean.

(NOTE: It is interesting to note that in 1888 France possessed 134 torpedo boats and eight destroyers without ever seriously threatening the British naval supremacy.)

The judgment of naval officers was impugned throughout some of these writings. The navy department was openly criticized. In so doing M. Charmes wrote articles extremely scurrilous in their tenor, and produced considerable public distrust toward the French Navy Department and its recommendations. Proposals and requests for money submitted by the navy department were for this reason not favorably considered by the legislative bodies. Conditions throughout the French Navy suffered as a consequence.

Examples of this form of argument have appeared not infrequently in the discussion concerning the airplane. A reference to French history is all that is necessary to show that no national

benefit can be derived from unreasonable criticism based on personal opinions without a thorough knowledge of the facts.

Another form of argument that appeared frequently in the French controversy and that is in evidence in our present discussion is the article or news item that relates the truth but not the whole truth. In France, M. Charmes was opposed by well-founded statements that the small type of torpedo boat that he advocated could not be considered seaworthy. He replied in an article stating that such objection was disproved by the voyage of a torpedo boat from Toulon to Brest, "weathering the tempests of the seas." He did not state that this boat skirted the coast all the way, sought shelter in sixteen harbors of refuge, and found it necessary to remove all possible weights, including her two torpedoes, in order to complete the voyage.

This type of article is present with us now. The bombing attacks on the old battleship hulls were described in many places as conclusive evidence of the superiority of the airplane. It was not always stated that the bombing planes were unopposed in the air by defending planes. It was not always pointed out that such attacks would, at least, not have been aided had the guns of the battleship been in action. Conclusions recklessly placed before the public are misleading and do considerable harm.

That these methods were used in the extreme by the French writers is not to their credit but, nevertheless, such articles made a decided imprint on the minds of the readers, who, having no better information, believed.

The *Nouvelle Revue* of July 15, 1885, tells of fantastic naval maneuvers in which the torpedo boats proved superior men-of-war to the armored vessels, and the same article demanded the adoption of the smaller craft and the dismantling of the large ironclads. Vice Admiral Bouchois replying to this article in his pamphlet *Les Torpilleurs,* gives us the attitude of most of the seasoned officers of the French service:

> The French Navy faces an important crisis. Shall France renounce the battleship to adopt the new engine of destruction, the torpedo, whose recent progress has brought about this crisis?
>
> That is the question that places itself with anxiety before all sailors and all citizens who think seriously of the future of the navy. The press discusses this question with an ardor that would be laudable if, in the expression of opinions, respect for opinions of others was always observed. This

respect has not been shown by the new enthusiasts. They do not hesitate to attribute opposing resistance to their arguments to a vile egotism on the part of sailors, engineers, and the members of the legislature whose ability and services have carried them to the head of their respective corps.

Throughout the time of this discussion there was one condition that caused doubt in the minds of the French people regarding the self-sufficiency of the torpedo boat. That was the known fact that Great Britain was not scrapping her ironclads as useless. In addition to this, a well-founded doubt existed as to the ability and suitability of torpedo boats for operations on the high seas.

M. Charmes combated the first idea by constantly presenting word-pictures of torpedo boats attacking ironclads successfully and by dwelling on the belief that Great Britain was making a fatal mistake in the pursuit of her policy to maintain "useless" heavy ships. The second idea, however, he could not argue against; the known facts were against him. Therefore, M. Charmes and his friends changed their tactics. Instead of continuing to claim that torpedo boats could, by themselves, command the seas, he commenced a campaign to show that torpedo boats, augmented by auxiliary vessels, could accomplish this end. Hardly had this new campaign gotten underway when persistent rumors were heard of a new class of British vessel, the torpedo boat destroyer, capable of high speed and carrying guns of sufficient power to destroy a torpedo boat.

Proposing a method to circumvent these new difficulties, M. Charmes writes in his book *Naval Reform:*

> But side by side with the attacking torpedo boat we should place another, that we might call a "defensive torpedo boat," and its mission should be to engage the enemy's torpedo boats so as to clear the course for its brother in arms. . . . . Its object being the pursuit of the enemy's torpedo boats, it can never go too fast for that purpose. Thus, we have two vessels of very nearly similar construction, but of different armament, one destined to attack by means of the torpedo, the other set apart for use against the torpedo boats. These two boats will always accompany each other, each of these couples forming a torpedo fighting unit. . . . .
>
> Our small boats, in long cruises, must be accompanied by transports. . . . . As a general rule they (the transports) will not defend themselves; they will merely be the base for supplies, the convoy for the torpedo vessels, and remain as much as possible away from the fighting. . . . . These transports, gunboats and torpedo boats will be vultures circling in pursuit of their prey.

What a similarity these plans bear to the proposed organization of the bombing plane: the attack plane, its defender, and the airplane carrier, its base of supplies!

Simultaneously with these new proposals, it was demonstrated in maneuvers of the French and British fleets that battleships could be protected by accompanying vessels properly formed into a protective screen. French enthusiasm for the torpedo waned accordingly. The torpedo proponents, however, did not lose heart. Acknowledging that the torpedo vessel might prove unable to attack organized fleets, they claimed that maritime power could be overcome by attacks of the torpedo boat units on enemy commerce.

Naval officers opposed this idea, contending that these small vessels could not capture large ocean-going vessels, that they could not carry prize crews and that they could not hope to carry to safety the crews of enemy vessels that might be sunk. Indicative of the extremes which M. Charmes was willing to favor, we find him an advocate of "Ruthless Warfare." He found space in the French press for the following:

> A war of chase has its own rules, and we must have the courage openly to own them. These are to fall without pity on the weak, and without false shame, and with all possible speed, to fly from the strong. . . . . Let no short-sighted philosophers tax us with barbarism. . . . . Although the means toward attaining this new strength for the weak may be terrible and barbarous, the results will certainly not be opposed to the cause of humanity.

Here is the climax of the torpedo controversy in France. M. Charmes and his adherents had, by journalism alone, converted to their extreme ideas a sufficient number of the public materially to affect the national defense policy. Having convinced many that the heavy ship was useless and that the torpedo boat was to become supreme mistress of the seas, they suddenly found that they were favoring a doctrine injurious to France.

For nearly twenty years this controversy was carried on. Finally, however, public opinion turned and the advice of the conservative element began to receive the attention of the people. The tenor of this advice is outlined excellently by Vice Admiral Bouchois in the following quotation from *Les Torpilleurs:*

> The mastery of the sea retains all of its importance. To attain such a mastery, defend it or even to protect the coast line, heavy ships are necessary. We should keep ours, especially in the presence of jealous nations

whose pride it is to build the greatest battleships, and who would not be displeased to see us destroy our naval forces with our own hands or even let them gradually deteriorate. These battleships which still form our navy must be provided with every means of defense that the industries and the naval art can furnish, awaiting the time when further progress shall impose a fresh transformation of naval material. In spite of the advent of the torpedo and the tests which have followed, the time seems not yet to have arrived. We express the hope that the substance may not be abandoned for the shadow and that, if our naval material must be reformed, it shall only be after a complete experimentation and trial of the types which are to compose the new fleet.

To place torpedo boats on a footing where the naval strength of France will be maintained, to create destroyers whose rôle shall acquire great importance from the fact that they annihilate torpedo boats, to protect the fleet from surprise attacks, seems to us to be the proper direction of our naval construction; and just as the confidence of the crews in their commanders and their material is the first element of success for a fleet, we entreat our opponents in the name of the interest of our country, which we both have at heart, not to seek to destroy this confidence by unjust attacks and heated criticism of the navy department.

In general, the controversy in France at the start resolved itself into a debate between strongly partisan groups. Teamwork was lacking, national confidence was destroyed. In spite of the need for strict economy, the absence of a nationally accepted naval policy brought poor returns from the naval expenditures. The navy became neither a well-balanced fleet nor a good torpedo boat navy.

In strong contrast to the conditions existing in France at this time was the spirit in which the British set about to solve the problem. The British Navy had always been close to the people. It represented then, as well as now, the strength and ability of the British Empire to exist. The navy was fortified by the highest traditions which were as dear to the people as the navy itself. For these and other reasons it was not easy to stampede the public into the belief that Britain's naval supremacy was being threatened by the new weapon. Although great anxiety was felt, any idea of scrapping the foremost fleet of the world was obnoxious to every British subject.

Fearful of the torpedo threat on the power of her ironclads, Great Britain did not give the torpedo an enthusiastic welcome. Much comment and space in the press was taken up with a demand for international agreement to outlaw the torpedo. They classed it as a cowardly and inhumane weapon of warfare. It was soon

apparent that other nations would refuse to accept any international overtures on the question and that the torpedo had come to stay.

The words of Admiral D. D. Porter, U. S. Navy, were often quoted in the British Parliament and press. One of the best outlines of the British idea of the time may be taken from a report of 1874 written by him.

> While I attach great importance to the torpedo as a means of offense and defense, I am yet afraid that we shall run into the error of supposing that ships of war can be driven from the seas by means of it alone. Some imaginative people think that ships and guns will avail nothing hereafter, but the torpedo will do all the work, while others who have not paid much attention to the matter consider the torpedo of little practical utility. Both these conclusions are erroneous.
>
> The torpedo, after all, is but an adjunct, and there are only certain times when it would have advantage over great guns. . . . . The torpedo, although an important addition to other means of warfare, will not do away with anything that has preceded it.

The same authority, Admiral D. D. Porter, U. S. Navy, in an article appearing in the *North American Review* in 1878, described from an outside and contemporary point of view, the general attitude of Great Britain:

> Among the arguments urged against the introduction of the torpedo was that its use would not foster the bravery and chivalry which have characterized the naval profession, more especially that of Great Britain. Great Britain, having the most powerful navy of the world, did not deem it prudent to encourage a mode of warfare which would tend to place her on an equality with weaker nations. Were it not for this obvious reason, she would, no doubt, have given particular attention to so effectual a means of destroying an enemy. Now that she sees every nation accepting the torpedo, and her splendid fleet of ironclads imperiled, she is with characteristic energy making every effort toward the improvement of this most terrible engine of war. As the torpedo has now been generally adopted among the navies of the world, she will provide effectual means of resisting it when sent against her fleet.
>
> At this moment no nation can afford to ignore the torpedo, either as an offensive or defensive weapon; to do so would be evidence that they have not observed the recent great improvements, or that observation has taught them nothing. . . . . It is true that the torpedo will not so change the character of naval war that great ships will be dispensed with, for in proportion as this engine is developed new contrivances for withstanding it will be invented. A nation that possesses the most powerful fleets will, as heretofore, dominate its adversaries on the sea, and we shall live to see

perfected torpedo boats engaging other torpedo boats on the ocean, as we see the light cavalry combats of two contending armies.

Available records from official reports, press reports and parliamentary speeches show the same moderation of tone regarding the ultimate solution of the torpedo problem and the firm belief in the heavy ship.

On May 8, 1876, Lord Brassey spoke on the subject in the House of Commons. He proposed a commission to be appointed "to consider the great changes which have taken place of late years in naval warfare, and to recommend the best type of ship to meet these changes." Continuing, Lord Brassey outlined his reasons for desiring such a commission.

> They are to report on the whole subject, and to enable Parliament to consider intelligently, and to legislate upon, naval affairs in all their branches. The report of the proposed commission should be an invaluable document in the hands of the first lord of the Admiralty in pleading with Parliament on behalf of the navy. It will not be necessary to make disclosures on points of detail. In Parliament, we want only that general information which will enable us to determine whether or not armor should be retained. We want advice as to the relative value of armored or unarmored ships.

In August, 1877, an article in *Macmillan's Magazine* states:

> In other words, defense against the ram and torpedo must be sought, not in the construction of ships alone, but also, and chiefly, in the proper grouping of the forces at the points of attack. Each costly ironclad ought to be defended against the torpedo by numerous smaller but less important parts of the general forces.

Sir Spencer Robinson, commenting on the subject, said:

> No fleet, therefore, can be considered a fleet unless provided with attendant vessels to meet those attacks to which it is sure to be subjected.

Lord Brassey, in writing for the press, shows his views regarding cooperation:

> The administration of the navy must never be degraded into a party or personal question. We are all united in one common object—that of creating and maintaining a powerful navy.

It is sufficient to state that the above quotations, in general, reflect the sentiment throughout Great Britain. The nation felt that the safety of the ironclads was threatened. They tolerated no expression of opinion not based on facts. They sought and demanded the truth. The thought of coordination was paramount.

No questionable methods were used to further the adoption of personal preferences or ideas. The national integrity was at stake and the nation presented a united front to work itself out of the difficulties.

The Admiralty conducted maneuvers and tests of all kinds to formulate the new requirements of strategy, tactics, design of vessels, modification of ordnance equipment and all kindred subjects. The naval architects of all great shipbuilding concerns were requested to consider designs for torpedo boat destroyers and for increasing the underwater protection of heavy ships. Improvements were made in design and operation of artillery.

The anxiety was great, the Navy was in a dilemma as to the best and most economical procedure to follow. Nevertheless, the records of the time show that no doubt was felt as to the eventual ability of the Admiralty to afford protection for the ironclads against the torpedo. (This nation-wide attitude is all the more remarkable in view of the fact that Germany, Russia, Austria and Italy had held up further construction of ironclads, had even laid up those in commission and were building hundreds of torpedo boats.)

Out of the British effort was originated the present day means of effecting protection against the torpedo craft. They provided sufficient torpedo boat destroyers to guard the fleet and, if opportunity offered, to launch an offensive torpedo attack. They altered the hull design of heavy ships, providing them with numerous bulkheads and compartments. They developed and provided a breech-loading, rapid fire gun capable of being easily, quickly and efficiently handled.

Perhaps it was lucky for Great Britain that peace reigned in Europe during this period of development. At the end of this time, however, the naval power of Great Britain was superior to that of the combined navies of any two nations of the world. The ironclads, moreover, were the backbone of her fleet.

The difference in the manner of accepting and utilizing the invention of the torpedo within the two great maritime nations of the '70's gives us reason to pause and consider well the best procedure for us to follow in the face of very similar circumstances. History has fortunately provided, for our consideration, the facts concerning a notable controversy. It has provided us with two

concrete examples, two roads that we may follow, one which, in the past, led to maintenance of the national defense, the other to serious loss of naval prestige.

Controversies of national and international importance have arisen in modern times over the invention or development of the frigate, the steam ram, the torpedo boat and the submarine. In each case the ship-of-the-line has been doomed by mistaken enthusiasts for national defense nostrums. In each case important modifications and methods have resulted. But because each of the smaller weapons has been restricted by its own limitations, the capital ship has continued as the pinnacle of sea power. Warfare has become more complicated. The smaller weapons have had their successes. But supremacy of the seas, with its attendant freedom for commerce and the activities of war, has never, in all history, been attained until the power of the capital ship has been nullified or destroyed.

The present article is not a defense of the battleship or of any particular naval weapon. What the writer endeavors to show, against a historical background, is the danger and futility of making radical changes in naval design and methods upon predictions of enthusiasts. Before making such changes, it is necessary, through thorough investigation and experiment, to demonstrate the truth or falsity of such claims. With a navy the equal of any in the world, the same interest must be displayed toward means of defense as toward the attack, so long as other powers continue to develop and maintain surface ships of war.

The French proponents of the torpedo, in their enthusiasm, refused to acknowledge the efficacy of any proposed means of defense against that weapon. Because they did not experiment, with equal diligence, on developing such defense, none satisfactory was evolved. This resulted in the torpedo appearing to be more invincible than was actually the case.

At the present time, in reference to the airplane, no one-sided development must be permitted to bring about a blinding effect on the possibilities of the future. After all, it is cheaper to build up the necessary means of defense during times of peace than to wait until the urgency of war imposes such requirements. If, after thorough and sincere trial, the national resources fail to produce adequate means of defense, then, and not until then, are

we safe in committing the safety of the nation to the new weapon.

For these reasons, when broad claims for strong offensive power are made by any class of enthusiasts, these same enthusiasts fail in their duty if they do not seek to provide equally strong defensive power. They are working definitely against the best interests of the nation if they, for any reason, exaggerate or attempt to mislead the people, whether in regard to the efficiency of the scheme or the cost.

The argument relating to cost is always a favorite one as being most appealing to the public. Of this, it is absolutely certain that claims for sweeping economy in the use of new weapons of whatever character are in no way justified by past experience.

At the present time articles are numerous in which a comparison is made between the cost of an airplane and of a battleship. But do the authors concerned state the life of a battleship as being ten times the life of a plane? Do they state that, for every fifty or sixty naval planes, of which less than half may be bombers, there must be an airplane carrier, a costly and especially built type of vessel? If not, are these authors furthering the cause of national defense, or are they engaging in a debate against those truly interested in the nation's welfare? The machinery of warfare, afloat and ashore, is every day becoming more complex, and every new and valuable weapon is adding to its complexity and cost. Economy in warfare by the use of new inventions is a delusion, as our recent experience should show.

In considering the merits of certain types of weapons, the term "capital ship" must not be misunderstood. That is where many who believed the torpedo to have revolutionized naval warfare made a serious mistake. They failed to visualize the "capital ship" of the future, believing the ironclad to have reached the zenith of such development.

The term "capital ship" is only another name for a unit of the fleet in which, for the period, as much fighting power and efficiency as practicable is concentrated. Progress in scientific investigation and in inventions will surely produce changes in the present types of vessels, weapons and methods. The "capital ship" of the future must be provided with adequate means of defense against the airplane. Whether these changes will involve improved ordnance, scientific discoveries, the carrying of numerous defense planes, or

any combination of the three, it is impossible to forecast. Naval designers must provide the answer based on practical experience, actual tests, knowledge of new developments, knowledge of new methods, and expert estimate of future advance in the art of war. Whether these things can be accomplished or not is receiving exhaustive study on the part of every navy department of the world. It may be indicative of the outcome to note that no foreign nation is showing signs of favoring the abolishment of its own battleships.

Navy departments recommend but do not control naval policies. Public opinion, as represented in the Senate and House of Representatives, controls such policies, together with the appropriation of funds necessary for promoting them. On this basis we are in no danger of coming to an erroneous decision in such matters so long as we demand and accept nothing but the truth and the whole truth. We shall receive no helping hand from abroad, nor shall we receive a staying hand if we permit our battleship fleet to deteriorate; therefore, the responsibility rests on every loyal citizen of the United States to make no claims, no assertions, which by nature exaggerate, mislead, or are untrue. In the absence of such statements and by teamwork and unity of purpose, the people of the United States will demand and maintain an efficient navy—not one composed largely of any particular type of vessel, but one which, by balanced coordination and proper ratio of required weapons, will produce "Defense Against Aggression and Protection of our Commerce and Interests Abroad."

AN AIR POLICY FOR THE UNITED STATES

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"POLICY," says a recent successor to Noah Webster, "is the system or measures adopted by the sovereign power of a country in the management of public affairs." In the implication of the term in the popular mind, however, that definition is narrowed by an insistence that the measures adopted must be consistent with each other and that they must be the product of an honest attempt on the part of all the parties in interest to anticipate the course of events and hit upon a course best suited to harmonize with probable future developments and, without frequent and violent modification, to tend with maximum efficiency toward the production of a desired final result. There must, in short, be a system, a system guided by a conscious intelligence, rather than a casual group of disconnected actions.

Judged by that standard, it becomes fair to say that the United States of America has never had and retained for any length of time a policy in aeronautical affairs as a whole. There has been great effort expended, and it has been backed in most cases by technical ability of rare, indeed in some ways of unique, quality. There have been, at times, generous appropriations. There have been a diversity and a multitude of laws flowing in an uninterrupted stream from legislative bodies ranging in scope and weight from the national Congress down to the boards of selectmen of insignificant villages, but, unfortunately alike for those interested in extending the use of aircraft and for those concerned only with protection from the danger resulting from their improper use, there has been little sign of consistency and continuity in all these acts of scores of different organizations.

What is air policy, and whence springs its importance? Why should we, as a people, worry about it? Why should we not leave the development of aircraft to chance and to private initiative inspired by hope of profit, confining our governmental interest to the purchase of equipment for the Army and Navy?

Definition, in this case, requires classification, a classification which can most readily be made under three headings corresponding to a like number of types of service, military, naval and commercial. Of the three, it is self-evident that the first two can be neglected only with grave danger to the national safety. No one who has given the slightest attention to the recent history of armaments, and in particular to the course of the rivalry between Britain and France in the air, will require either explanation or argument for that statement. As for commercial air policy, persistently to ignore its importance would be symptomatic of an indifference to the possibilities of new and improved means of transport, and a national self-complacency with things as they are, which would be the sure precursors of national decay.

The military and naval aspects have so far fared better in this country than have the commercial ones, for they have had the continuous attention of the two services, while it has been no one's particular business to stimulate interest in the more peaceful uses of aircraft. In the activities of the Army and Navy it has been possible to complain only of a certain lack of correlation of effort which has grown out of an excessive rivalry between the services and between certain factions within them, and of an insufficient continuity in the selection of new types of aircraft for production. The first of those difficulties has been in part the result, in part the cause, of the very protracted and heated dispute as to the relative merits of a separate air force and of the existing system of the maintenance of two air services under the control of Army and Navy, respectively. That argument has at one time or another had a counterpart in most European countries. Great Britain actually adopted the separate air force policy some years ago. Italy, Russia and some other states of less importance have taken the same step, and the French have it under consideration, the debates on the subject in Paris being almost as warm as those in Washington. The second source of complaint, more technical in its nature, has been a natural result of the rapidity of the development of the art and of the consequent difficulty of deciding, at any given moment, which of a dozen tentatively-initiated lines of experiment it will be most useful to pursue The results are none the less unfortunate, for the ideal fighting airplane, to take a single type as an example, will never be secured by giving to six or eight manufacturers orders to produce

a single machine, or two or three to the same design, each in accordance with his own ideas, and then switching the same group of factories to some other radically different type after all of the designs submitted have been found incompletely satisfactory. The aeronautical art is still to some extent dependent on trial and error, and the best results will be attained only by painstaking step-by-step development, in the course of which a single man or a single company should produce a long succession of airplanes for the same purpose and all designed closely along the same lines, the latter examples of the series being derived from the first by the somewhat tedious and humdrum process of removing defects as they appear, one by one. Brilliant invention is less needed now than careful attention to minute detail. There is much less ground for criticism on this score now than there was three or four years ago.

These criticisms of military policy are of relatively minor importance. Of air policy in its relations to commerce, constituting the third of the main subheadings, a less pleasant story has to be told. The great outstanding fact, on which all discussions must rest, is that the non-military use of aircraft has not yet been taken seriously by the American people as a whole or, with the distinguished exception of the remarkable work done by the Post Office Department in carrying the mails by air, by their government. While virtually every state in Europe, from the greatest and most powerful to the weakest and most completely bankrupt, has been giving both direct and indirect financial aid to air transport companies, there had not been passed by Congress until January, 1925, a single measure designed to lend the slightest encouragement to the operation of air lines by private enterprise in this country. The Kelly Air Mail bill, which became law during that month, constitutes a distinguished exception to the general rule of indifference. If a real policy is to be sought and adhered to, at least we have the advantage of being able to start with a nearly clean slate.

There are a number of motives which might properly impel us to give careful heed to the future of commercial flying, motives which may be broadly classified as military, political, and economic. Of the three groups, the military factors have undoubtedly been uppermost in bringing certain European nations to the granting of a subsidy, but, however that may be at the present time, the

military interest of commercial flying will inevitably recede into the background and purely economic considerations will come more and more to the fore as time goes on. That development will be inescapable because the airplane and airship are needed for transportation. They furnish good transportation and efficient transportation. They travel at more than twice the average speed of any other means of conveyance now existing. Air travel is not excessively dangerous, and, considering the nature of the service rendered, it is not excessively costly, but commercial aircraft must be planned and judged as vehicles of peaceful transportation alone. The best commercial airplane and the best machine for military use are very different in form, and the attempt to adapt every airplane for easy conversion to military use, an attempt now made by several European nations, can only prove destructive of efficiency and so can only result in depriving the business community of the benefits of an air transport service, while at the same time failing to stimulate an aircraft industry large enough to be of material service in time of military need.

In the future of commercial aviation, then, and in America more than anywhere else, attention must be centered on the fitting of the airplane and airship into the nation's transportation system at those points where there is most demand for them and where they will most increase the efficiency of a system as a whole. If that be done, a military advantage will accrue indirectly and unsought, for anything that increases the use of aircraft will serve to increase the number of trained pilots and mechanics available and to augment the nation's facilities for the production and repair of aircraft and their parts.

As for the political factor, the effect of air transport on foreign relations may be expected to be less on the American than on the European continent, although even to us it should be a matter of some concern that intercontinental airship communication, and especially that with South America, should not be developed solely by European nationals. A line connecting Spain with Rio de Janeiro and Buenos Aires is already seriously projected, and if the plans are put into effect before any corresponding move has been made in the United States the distance from the metropolises of the Southern Continent to London and Paris, measured in days of travel, will become less than half that to New York. It

will, in fact, be quicker to travel from the Argentine to Europe by air and thence to New York by liner than to take the direct sea route. Air transport in the Western Hemisphere should be of primary concern to the United States, but at present the only two air lines in regular operation in South America are under German control and a French mission is engaged in making a preliminary survey of the Central American field.

Within the Eastern Hemisphere the political importance of air lines, as of every other form of transportation, appears in every direction, and hardly a single one of the routes now being exploited fails to fit neatly into a national plan for the extension of national influence and prestige, either into far-distant colonies or into parts of the world where the great powers are now in, or are likely soon to come into, competition in their efforts to control the action of the local government. French airplanes travel on regular schedules over half a dozen routes in northern Africa, and the roar of an aero engine has become a familiar sound over the Sahara. France and Germany both have an eye on communications with Russia, and France, Britain, and Germany are all bending their efforts to the establishment of connections with the Middle East, approaching from three different directions. French enterprise has so far reached Angora via Constantinople, the Germans fly to Moscow and thence south to Teheran, and the British are carefully paving the way for the opening of an airship service which will run all the way to Australia, presumably with stops in India and in Persia or Iraq.

Always, however, one must return from the political, as from the military, factor to the consideration of the direct economic benefits to be derived. The United States Post Office Department has shown that the mail can regularly be flown from coast to coast in thirty-two hours, as against a train time of ninety hours, a relative saving greater than that made in the time of transatlantic passages from the *Great Western's* record of ten and one-half days, set up three-quarters of a century ago, down to the present day. If the modern liner, a craft essentially uneconomical in operation, and having no distinctive merit except speed, has earned a place in the economic world, there must be a place there as well for aircraft, which offer the same advantage in a far larger degree. It is for that reason that this country needs

a commercial air policy, and it is for that reason that we should plan now to extract the maximum of national profit from a form of transportation sure to grow in importance with the passage of time.

The first link in any such policy must be some measure of regulation of the operations of aircraft. Such regulation is necessary, first of all, for the public safety. The dangers of flying can be reduced to a point where they should not deter any traveler from taking passage by air, but that can only be done by using proper equipment properly maintained and operated by competent men. At the present time anyone, however slight his training, is free to purchase a decrepit airplane for a few hundred dollars and not only to fly it himself, a constant menace to those on the ground below, but actually to solicit the patronage of would-be passengers who lack the technical knowledge to realize the deficiencies of the machine and pilot to whom they are entrusting themselves. Conditions being what they are, it is little less than miraculous that accidents have been so few.

The operator of aircraft has reason to favor the enactment of some measure for federal regulation from a purely selfish point of view. The experience of American railroads has been sufficient to indicate that regulation is inevitable sooner or later, and that a period of complete freedom from control is almost certain to be followed by governmental action excessive in amount and unwise in form. Furthermore, the individual states are already acting, and it is intolerable that elaborate and conflicting sets of requirements should be enforced by political units so small that half a dozen of them may be crossed during a single flight. State regulation would be preferable to none at all, but the states should abdicate in favor of Washington as soon as Congress gets around to the point of taking action already long over-due.

Federal regulation implies the existence of a controlling organization, and the Wadsworth Aeronautics Bill, passed by the Senate in the sixty-seventh Congress and re-passed during January, 1924, and the Winslow Civil Aeronautics Bill introduced in the House and just brought in with a favorable report by the Committee on Interstate and Foreign Commerce at the time when this article is being written, are alike in providing for the creation of a Bureau of Aeronautics in the Department of Commerce. Such a bureau could perform a service of tremendous value, out-

side of its regulatory activities and at very little expense, by furnishing a clearing-house for the exchange of information on subjects of general interest. At the present time the Army and Navy are independently doing work in the collection of information on landing fields and air routes which is of great value but could far better be centralized in a civilian Bureau of Aeronautics having the cooperation of the services and access to such information as they already possess. New discoveries and new data affecting the safety of flight, wherever and however made or secured, should be at once made available to all pilots and owners of aircraft, and there is no other way in which that can be done so effectively as through the organization that licenses the pilots and registers the machines. This does not, of course, imply invasion of proprietary rights in inventions, but only the distribution of information gained through governmental channels and of suggestions of methods of maintenance and operation which collective experience has shown to be profitable.

More important than the exchange of information among the operators of aircraft, however, is exchange between those operators and the public. A prime essential in the development of air transport is the stimulation of public confidence in the safety and reliability of aircraft, and that requires the distribution, in statistical form and otherwise, of the real truth about flying. Compared with records of achievement, no one's opinions are of the slightest interest. Unfortunately, however, no such records now exist in the United States. The British Air Ministry publishes each year a statistical and descriptive report on commercial flying during the previous annual period. The number of miles flown on each route, the number of passengers and the weight and value of the goods carried, the percentage of reliability, and the number of accidents, when any have occurred, all are listed in detail, with comparisons with the performances of former years. More than that, when any accident does occur an official investigation is promptly made by the technical staff of the Air Ministry and a report on the causes of the mishap, with recommendations of the precautions to be taken to avert a repetition, is published. Much the same thing is done in France. Much the same thing is done in Germany. Only in the United States does the operation of aircraft proceed on purely haphazard lines, and

only in the United States is it absolutely impossible for any human being to say, or to find out, how much flying is done and of what type and how many accidents occur and why.

The importance of federal regulation is not a thing only recently apparent, and it is not the fad of a few people. The matter is one on which there is, and has been for five years, virtually complete unanimity of opinion among all who have made the slightest study of civil flying here and abroad, and it is difficult now to find phrases not already worn threadbare in pleading the cause of aviation before Congress. In its report for 1920, the National Advisory Committee for Aeronautics, a body of America's most distinguished scientists, appointed directly by the President and serving without pay, said: "The committee is unanimous in supporting the Kahn Bill [later superseded by other measures accomplishing the same end] as modified. The most urgent need at this time is the development of commercial aviation under Federal regulation." In 1921 the same committee stated first among its recommendations for that year that "The committee renews its previous recommendations for the establishment of a bureau of air navigation in the Department of Commerce, for the Federal regulation and licensing of air navigation, and to aid generally in the development of commercial aviation," and in transmitting the report to Congress President Harding wrote: "I therefore urge upon the Congress the advisability of giving heed to the recommendations of the committee, the first and most important of which is that a bureau be established in the Department of Commerce for the regulation and development of air navigation." In 1922 almost the same phrases were repeated. In 1923 the committee said: "The committee again recommends the creation by law of a Bureau of Civil Aeronautics in the Department of Commerce for the regulation and licensing of aircraft, airdromes, and aviators, and the general control and encouragement of commercial flying," and President Coolidge, in his letter of transmittal, expressed himself as wishing "especially to endorse the recommendation of the National Advisory Committee for Aeronautics for the establishment of a Bureau of Civil Aeronautics in the Department of Commerce," an endorsement later reiterated in his annual message to Congress. Yet nothing has actually been done, although, to be sure, the outlook

for action is far more encouraging now than at any previous time.

Provision for Federal regulation, however, necessary though it is, does not constitute an air policy in itself. More than that is needed. There must be aid to proper flying, as well as restraint on that which is improper.

If we look to the practice of other countries, where commercial air transport is actually flourishing, for a guide, we shall find plenty of precedents for the granting of aid of the most direct sort, for practically every European state of any importance now gives a cash subsidy to the operators of aircraft. That unanimity of action, however, is largely the result of competition, for obviously a line running without subsidy cannot compete with a heavily subsidized enterprise operating on the same route under another flag. No such factor would act as an argument for a subsidy in the United States, where most of the flying done would be between points within our own borders, and no subsidy need be considered here. A subsidy, unless administered with great skill, acts to stifle business initiative and may easily do more harm than good. Aviation should, and must, get along without any such artificial stimulus.

In speaking of aid to proper flying, then, no cash grant is implied, and the aid furnished should be designed only to insure fair competition, not to guarantee profits to services operated in the face of an absence of any economic warrant for their existence.

It is obviously impossible for two or more companies serving the same route to compete on an equal footing if one is subject to heavy expenses of which the others are relieved, and if those expenses relate to the provision of facilities which must be available before there can be any flying at all the first company to undertake the service must assume them for the benefit of all its rivals as well as itself. The first in the field are then placed at a definite and permanent disadvantage, independent of and additional to the ordinary hazards of pioneering.

Landing fields, route marks, and lighting arrangements along a route are inescapably available to all who fly, whether or not they have made any contribution to the cost and upkeep of those ground facilities. There is no parallel between the railroad, which can reserve its right of way and its terminals to its own use or permit their use by others only after payment of whatever rental

is demanded, and the air line. The analogy should be drawn rather between the air line and the shipping enterprise, and the ground organization for the use of aircraft should be provided by the government exactly in the same way, and for exactly the same reasons, that lighthouses along the coast and harbor facilities are provided by the governments of the world today. That seems so self-evident as to require no proof. When the necessity of governmental aid of that sort finally gains proper recognition it will become the duty of the Bureau of Aeronautics, if that badly-needed organization has by then finally been brought into being, to lay out a comprehensive scheme of airways for the United States, planning with an eye to commercial and economic considerations alone, and to decide on the manner and the order in which they should be developed.

Although the provision of landing fields and lights and aerial signposts and the broadcasting of general weather reports and storm warnings are necessary preliminaries of any commercial flying on a large scale, other inducements to capital should be offered to tide over the difficult early period during which the public is becoming accustomed to the idea of traveling by air and shipping its goods in that way. The easiest and most obvious of such inducements, and one which involves no expense whatever to the government, is found in the granting of a monopoly franchise for a term of years.

The spirit of American political thought has long been anti-monopolistic, but one must recognize the facts of a particular case. In its early stages, air transport is a natural monopoly, for there is little temptation to those who control capital to expend great sums and great efforts in developing traffic if others with smaller resources are free to come in at a later date and build on the foundations that they have laid. Aircraft are common carriers, and they may be made subject to complete government control. Let the government, then, offer exclusive franchises on some of the more important routes, guaranteeing against all competition for a period of ten, fifteen, or twenty years, and there will be some prospect that before the end of that time an adequate return will be gained to cover the cost of preliminary work.

Such action would have ample precedent both here and abroad. When the first long-distance railroads in this country, and especially those across the continent, were being built it seems to have been accepted as axiomatic that some reward must be offered to their builders. The grants of land ultimately to be of enormous value resulted. Any proposition that all the risk should be assumed by one company, with another coming in to parallel the original lines exactly and take away a large share of the business as soon as the country had begun to open up and it had become apparent that the enterprise was to be successful, would have been regarded as too ridiculous to merit discussion.

Another parallel for official limitation of competition is found, at a more recent date, in the story of European air transport. From the operation of air lines by a number of competing companies each country has progressed steadily toward monopoly, and the final step has been taken in Great Britain in the formation of the Imperial Airways, Limited, destined to assume complete control of all commercial operation of British airplanes on regular routes between the British Isles and other parts of Europe. A similar combine had been formed in Germany about a year previously.

Government interest in the operation of aircraft can find only one other proper avenue of expression, the actual provision of business in the carriage of the mails. The usefulness of the airplane in that field has already been more clearly demonstrated in the United States than anywhere else in the world, thanks to the extraordinary achievements of the Air Mail. That service has been in operation for six years now, and for more than three of the six the whole transcontinental route has been covered, every part of the distance between New York and San Francisco being covered in each direction every day. The aggregate distance flown is over two million miles a year, and the average percentage of perfect performance is over ninety for the whole year and often is above ninety-nine during the summer months. More significant still, it was by the Air Mail that the first serious attempt at commercial flying by night was made, and the experiment was attended with such complete success that the whole route between Cleveland and Rock Springs, Wyoming, is now lighted for night flying and a twenty-four-hour service is given

throughout the year. The Air Mail has been invaluable as a laboratory of commercial flying and a source of data on costs of operation and other kindred matters, to say nothing of possessing a direct usefulness in accelerating the delivery of the mails which not only justifies but demands its continuance. Any air line to be started in the United States, whether it transports passengers, mail, or express, will owe a heavy debt to the pioneer work of those who have flown the mail since 1918, and any outline of prospective air policy which failed to emphasize the necessity of continuing the work so well begun would stand condemned as wholly inadequate.

The Air Mail should not, however, be spread out to routes entirely distinct from that now served. The channels of government operation are often tortuous, and the aim should be to enlist private enterprise as soon and as fully as possible. Besides, the merits of this service in offering an opportunity for experiments, the results of which will be made available to all interested together with full information on operating methods and problems, would be sacrificed in large part if the present unity of service were to be lost. Concentration on the further development of the route across the continent, with extensions along the coasts for moderate distances from the present terminals, will accomplish far more than an attempt to diffuse governmental efforts through the forty-eight states, even though all need and must ultimately enjoy the benefits of an aerial postal service.

They can best receive that service under private operation. The time has come when contracts for the carrying of mail by air should be entered into by the government quite as much as a matter of course as contracts are awarded for the rail transport of postal matter. Both in the last Congress and in the present one bills were introduced to permit the Postmaster General to make arrangements for the aerial transport of mail on such routes as he might select, and the Kelly Bill for the accomplishment of that end was finally passed and signed by the President on February 2, 1925. It is to be hoped that the first contracts will have been signed before this article appears in print. Action on the handling of mail by private air lines is desirable not only because of the direct benefit in the saving of time on a multiplicity of routes instead of on a single one under direct government operation, but also because it will stimulate the starting of the air lines,

which will then be available for passenger and express business as well as for the service of the post office. The statistics on the amount of mail matter of various classes traveling on particular routes are sufficiently complete so that the quantity likely to be shipped by air can be estimated in advance with considerable accuracy. The government would then be in a position, without risk of appreciable loss, to guarantee a certain load on each trip, and the successful bidder for a mail contract would thus have a definite minimum income which he can rely upon for the duration of his contract provided only that he keeps the service up to the prescribed standard of regularity. That income will keep the enterprise afloat, even though the passenger business may be relatively slow to develop, and there is nothing which will bring passengers forward more quickly than the daily sight of airplanes passing overhead on a regular schedule, without accidents and without delays. The operation of an air line, whether the cargo be a diversified one or be made up in the early stages almost solely of mail matter, serves to stimulate that public confidence in air travel, by the growth of which that same air line will be the first to profit. Insofar as this nation as a whole will ultimately be the gainer by the addition of air transport facilities to its existing transportation system, the letting of mail contracts now will offer an indirect advantage in addition to its direct and obvious beneficial effect on the postal service itself.

The federal regulation of flying, the creation of a bureau to administer that regulation and serve as an aeronautical clearing-house, the provision of landing fields and other necessary ground facilities and aids to navigation, the granting of monopoly for short terms, the continuance of the Air Mail, and the letting of contracts for the aerial transport of mail by private companies, these are the essentials of a sound American air policy in its relations to the operation of aircraft. The relations of such a policy to the production of flying equipment and so to the aeronautical industry also need very careful analysis.

Manufacturing organizations are incapable of indefinitely rapid expansion in time of need, and they cannot be called into being by magic. If the waste, inefficiency and delay which unfortunately but inevitably characterized certain phases of our participation in the late war are not to be repeated in an aggravated form in

any future emergency of similar nature, a full plan of action must be formulated in time of peace and there must be created at least a skeleton of the organization necessary to put the plan into effect.

War needs in munitions and equipment may be met by an increase of the size and productivity of existing plants or by the conversion of factories to work other than that for which they were designed and normally used. The second method serves very well for shells, which can be made in any large machine shop with relatively little preparation, or for toxic gases, to the production of which dye works and other chemical plants can be turned within a very short time. For manufacturing units so complex and specialized as complete aircraft, however, dependence can be placed with safety only in organizations created for that work and actually experienced in it.

If so great a misfortune as a war between the United States and any one of the other major powers should come to pass, it is probable that we should require, within the shortest possible time, a productive capacity of at least 5,000 airplanes of moderate size each year. While the ratio in which an industrial organization can be expanded in a very brief time and without disastrous effects on efficiency is necessarily somewhat indeterminate, such analysis as could be made involving a variety of factors which cannot be discussed in detail here, a five-fold increase may be taken as reasonable in this particular case, due regard being given to the possibility of splitting up the work of manufacture and sub-letting contracts for the production of certain individual elements of the structure to qualified companies outside of aeronautical circles, the aircraft factory specializing on the more elaborate and difficult parts and on the assembly of the completed whole.

To insure ability to cope with war demands, then, there should be an American aircraft industry capable of building a thousand airplanes a year, and, if that number cannot actually be built and sold, either to the government or to private purchasers, the industry can be kept up to the point specified only by government subsidies which will directly cover the cost of maintenance of an engineering staff and a nucleus of shop organization. Repellent as is the idea of industrial subsidy, whether frankly avowed or disguised, such grants may sometimes be justified as a purely military measure. It will be far better, however, from every point

of view, if the commercial and private demand can be so stimulated that, together with the normal requirements of the government services, it suffices to consume the normal product of an industry of size commensurate with the requirements of national safety.

To build a thousand airplanes a year with the expectation of a future demand either constant or growing gradually and steadily is one thing, but to produce the same number, knowing that the output may have to be quintupled almost overnight, is quite another. Preparation for emergency expansion is, in itself, a costly process, and it is only fair that the government should meet the extra expenses involved in such preparation. It is altogether proper that the price paid for airplanes for the use of the Army and Navy should be higher than that for identical machines sold to private owners, and such a discrimination should not be considered as being in the nature of a subsidy. If it be accepted that a certain degree of strength in a national aircraft industry is a national necessity, any private sale represents a net gain, a partial carrying of a burden which the government would otherwise have to support in its entirety.

An efficiently operated air line, getting a maximum of service out of each piece of equipment, needs but few new aircraft, and it is improbable that the manufacturers of airplanes will ever find a market of first-class importance among the companies engaging in the transport of passengers and express. A much better prospect lies in the sale of airplanes to private individuals for touring use, and any steps which can be taken by a Bureau of Aeronautics, or by any other organization, to facilitate and encourage such use will represent a direct contribution to preparedness for war, as well as to the convenience and pleasure of those who purchase or have any use of the airplanes. Thus, again, there appears a link between the commercial and military wings of air policy, but again there exists also a direct and non-military motive for a speedy development of civil flying in the United States.

SERVICE SINCE GRADUATION
vs.
AGE IN GRADE RETIREMENT

COMMANDER J. S. MCCAIN, U.S.N.

THE estimates in this article relative to the class of 1907 are based on the following assumptions:

First: That there will be no change in the number of officers in the line upon which the present numbers in the upper ranks were fixed: namely, 4,743.

Second: That there will be no casualties in the classes senior to the class of 1907, or in that class itself.

Third: That there will be no officers senior to 1907 passed over by selection for the rank of captain. In other words, the situation on July 1, 1924, is projected, without change except for promotion and forced retirement for age or service, into the future for nine to twelve years hence.

Now it is quite probable that there will be an increase in line strength. Such increase will directly benefit the fortunes of the class of 1907 over and above the situation as explained in this article; the number of officers passed over for promotion to captain and thereafter retired, who are senior to 1907, will also directly benefit that class over and above the estimates in this article; also, casualties within the class will increase the chance of those remaining on the active list, as will also casualties among seniors. On an average, nine per cent of each class has heretofore been passed over for promotion to captain.

When appropriate increases in the number of promotions accruing to 1907 have been made for increase of the Navy, and for officers senior to 1907 being passed over, and for casualties within the class itself and among officers senior to that class, it will be found that the opportunity of that class for promotion will be just about normal for promotion of commander to captain. It so happens that that class will be the first to feel the effect of average con-

ditions. The situation for that class, therefore, is not nearly so bad as pictured in the following paragraphs. They were written in order to compare the two methods of retirement, and the facts on July 1, 1924, are as fair a basis for that comparison as if changes in those facts were taken into account in future estimates, since such changes would have an equal effect under either method of retirement.

As between age-in-grade retirement and service-since-graduation retirement there is little or nothing to choose in regard to average number of vacancies or promotions, average length of service in grade and average age of attaining a grade. Such differences as may be are so slight as to justify dismissal without comment.

However, there is a great difference in the opportunities for promotion as between individuals and it is necessarily the reaction of individuals to the differing effects which will determine the comparative worths of the two methods. This will be illustrated by discussing the prospects of the class of 1907 under the two propositions, this class having been the object of considerable solicitude.

The table shows the line of the Navy divided by ranks, within ranks by Naval Academy classes or years of service since graduation, and within classes by fiscal age.

The Naval Academy classes are arranged according to seniority in each rank, but it has not been practicable to indicate the seniority of individual officers within a rank or within a class. Officers selected for promotion in June are shown as advanced to the rank for which selected.

Also, officers who have been passed over and later promoted or who have lost numbers within a rank, appear, nevertheless, in the class with which they graduated. This is somewhat confusing and detracts slightly from the exactness of estimated results. Officers should allow therefor in figuring out their personal fortunes.

The class of 1907 is a large class in comparison with classes senior and immediately junior thereto. Its mere size has so singled out that class that it has become the horrible example for service-since-graduation retirement and a tower of strength for age-in-grade retirement.

Briefly, service-since-graduation retirement would substitute for retirement as lieutenant commander, commander and captain at forty-five, fifty and fifty-six years of age, retirement after

twenty-three, twenty-eight and thirty-five years of service since graduation, respectively.

It has been proffered that retirement since graduation will largely decrease the opportunity which members of this class now enjoy under age-in-grade retirement and that disruption to the service will be caused by so large a number being eliminated in one year. The class of 1907 is in hard straits under either plan. The class of 1905 will be the last to pass under the captains' wire without forced elimination. The class of 1906 will have some trouble, while the matter will be entirely serious with the class of 1907.

The two assertions to be investigated are, first, that there is less opportunity in the aggregate for the members of the class of 1907 under service-since-graduation, than under age-in-grade retirement, and second, that more officers will be forcibly retired in the year 1935, when the class of 1907 will have completed twenty-eight years of service, than in that same year or in years adjacent thereto under age-in-grade.

Referring to the table again—under service since graduation the vacancies and the only vacancies which will accrue to the class of 1907 are the vacancies occasioned by the class seven years senior to it, that is, the class of 1900. When the class of 1900 shall have completed thirty-five years of service since graduation, that class will, in the year of completion of such service, either be promoted to rear admiral or retired, and vacancies in the captains' grade will be created to the number of that class.

Now the number shown in the table in the class of 1900 is the number of vacancies available for the class of 1907. This number is thirty-four—that is, thirty-four of the class of 1907 will be promoted and ninety-one will be forcibly separated from the service under service-since-graduation retirement.

There are three policies for the Selection Board to pursue in functioning under age-in-grade retirement. The aggregate opportunity of the class of 1907 will be shown under each of those three policies and together with the number of forced eliminations compared with the result obtained under service-since-graduation.

The first policy is the method which has been pursued in the past—that is, fairly close adherence to seniority with a narrowly restricted field of effective eligibility.

The second policy is to restrict the field of effective consideration to officers of that age group which would retire in the next forthcoming year, excluding officers who are younger in age, though senior in rank.

The third policy is a combination of the two foregoing: that is, to consider all officers, however young, whose seniority places them in what has been considered in the past to be the field of effective eligibility, together and on even terms with those officers who will retire for age in the forthcoming year, if not selected. This makes a wide field for selection.

Any member of the class of 1907 who is so fortunate as to make captain under present law, must make it as a result of operation of one of these three policies, so if their effects are demonstrated, the chances of that class under existing law, will have been fully explored.

The result of the first policy is estimated in the following paragraphs:

There are two members of the class of 1907 who are commanders and are in the 41-year age group. Under the first policy these two have no chance at all. In the next youngest group, that is the 40-year age group, there are thirty-five members of the class of 1907, who will face retirement in the fiscal year 1934.

In the year 1934 the captains who were, on July 1, 1924, forty-six years of age, will create vacancies in the captains list by promotion and retirement. This number is twenty-six. In the 40-year commander group, however, there are fifty officers senior to the class of 1907 and there are also a considerable number of officers senior to that class in the 37-, 38- and 39-year age group. Therefore, the thirty-five members of the class of 1907 in the 40-year age group will retire without an opportunity for promotion.

There are thirty-seven members of the class of 1907 shown in the 39-year commander age group; there are senior to that class, and in that age group, twenty-six officers; and in younger age groups, but senior in rank, twenty-three officers, a total of forty-nine officers senior in rank to those members of the class of 1907, who are thirty-nine years of age.

Thirty vacancies, allowing for the probable promotion to captain of members of the classes of 1901 and 1902, who are now commanders, will accrue to these officers in 1935, and it may, therefore,

be stated also that this group of thirty-seven has no chance for promotion.

In the next age group, or the 38-year commander age group, there are twenty-six members of the class of 1907 and there would be a small number, possibly thirteen officers, in other classes senior who would not have been promoted. There would not be more than thirty-four vacancies for this group and not more than twenty-four available for the class of 1907. If the remaining members of the class of 1907 are promoted in order of seniority, then the twenty-four promotions which accrue to the class of 1907 would be made proportionately from the group of five shown in the 36-year age group; from the group of twenty shown in the 37-year age group and from the group of twenty-six shown in the 38-year age group; that is, twelve will be promoted from the twenty-six men of the class of 1907 in the 38-year age group, and fourteen would go out without a chance. The promotions and retirements of that year, when accomplished, would leave three members of the class of 1907 in the 36-year group and ten of the class of 1907 in the 37-year group not yet promoted, a total of thirteen who would be promoted in 1935.

The following is a tabulation of the foregoing estimates:

Age group	Officers retired without a chance	Officers Promoted
41	2	—
40	35	—
39	37	—
38	14	12
37	—	20
36	—	5
	—	—
Total.....	88	37

The result of the second policy is much easier to determine. In estimating the results of this policy it is merely necessary to determine the number of officers in each age group and the number of vacancies available for that age group. The class of 1911 will become commanders by 1934. Therefore, lieutenant commanders of that class and of classes senior thereto are included in the age groups of commanders.

There are a total of ninety-six officers in the 40-year age group; thirty-five of whom are in the class of 1907, competing for twenty-

six vacancies; on a fair division, nine would fall to the class of 1907 and the remaining twenty-six of that class would retire.

In the 39-year age group are 116 officers, thirty-seven of whom are of the class of 1907, competing for thirty vacancies (assuming that eleven commanders of the classes of 1901 and 1902 are promoted to captain), nine of the class of 1907 being promoted and twenty-eight retiring.

In the 38-year age group are 107 officers, twenty-six of whom are in the class of 1907, competing for thirty-four vacancies (assuming that fifteen commanders of the classes of 1900, 1901, 1902 and 1903 are promoted to captain), eight of the class of 1907 being promoted and eighteen retiring.

In the 37-year age group are 110 officers, twenty of whom are in the class of 1907, competing for thirty-three vacancies (assuming that twenty-five commanders of the classes of 1900, 1902, 1903, 1904 and 1905 are promoted to captain), six of the class of 1907 being promoted and fourteen retiring. There are five members of the class of 1907 in the 36-year age group, of which one would be promoted, a total of thirty-three of the class of 1907 being promoted and ninety-two retiring.

Under the third policy precisely the same number of vacancies will accrue to the class of 1907 as under the second policy. The old men would suffer to a degree, however, for they would lose opportunities to the young men in immeditately senior classes, which, to the same extent, would be gained by the young men in the class of 1907 from the older men in immediately junior classes. There is no change in number estimated to be promoted or retired.

Comparisons of the effects of the various methods on the class of 1907 show that under present law thirty-seven vacancies would accrue to the class of 1907 under the first policy and thirty-three vacancies would accrue under the second or third policies, whereas under service since graduation but thirty-four vacancies would accrue to the class of 1907. Thus it seems that the class does have a slight advantage under the present law, but so slight is the advantage and so marked is the discrimination against individuals that it may well be called a Pyrrhic victory.

The first policy is the policy of the past and of the present. The service is well acquainted with its effects. If twenty-five per cent of each class is the normal elimination in going from one grade to another, then the older twenty-five per cent of each class has no chance of promotion. If fifty per cent is the average, then the older half of each class has no chance.

If the second policy is pursued there will be a two-year fringe at the top of each grade who have been passed over for no other reason than that they are young; that is, the younger men passed over under this policy would form the same percentage of each class as would the older men of that class who have no chance under the first policy.

If the third policy is pursued an unmitigated hodgepodge of young men passed over and old men with little chance of promotion will result. Both of the last two methods call for useless shifts of seniority.

It seems impossible that either of the two last policies can be pursued. There is too much of a sameness of excellence among the records of officers. Theoretically, of course, the very simple process of taking the "best man" would be followed. It would be a curious and interesting thing to know just how many times the Boards of Selection have found it necessary to apply the seniority factor to professional efficiency multiples in order to arrive at a choice.

The discussion relative to the class of 1907 is almost academic since it will be ten years before that fine body of men is threatened with disaster. Ten years is a long time in personnel history; emphatically so, in view of the general interest in personnel matters.

Now consider the assertion that more officers will be retired from the class of 1907 in 1935 under service-since-graduation than would be retired in all classes in that year or years adjacent thereto under age-in-grade retirement.

It has been shown that ninety-one of the class of 1907 will retire in 1935 under service-since-graduation retirement. For purposes of comparison there will be left out of consideration the officers who are senior in rank but younger in age than the age groups specified. Of course some of these younger officers will be promoted in lieu of the officers in the age group concerned. The

number promoted will increase proportionately the number of officers retired for age-in-grade.

In 1935, under age-in-grade, commanders in their forty-ninth year will retire if not promoted. There are 116 officers in this age group of the classes down to and including 1911. These 116 officers will compete for thirty vacancies and eighty-six of them must retire. Thus, only five less would retire this year under age-in-grade than would retire in the same year under service-in-grade retirement.

In 1936, seventy-three officers would retire under age-in-grade and seventy-six under service-in-grade. In 1937, seventy-seven officers would retire under service-in-grade and seventy-nine would retire under age-in-grade.

As a matter of fact, in some years more officers would retire under age-in-grade than under service-in-grade and in other years more officers would retire under service-in-grade than under age-in-grade. However, the average retirement must be the same under either method. Differences are purely local and there will be no greater disruption to the service by reason of one plan than by reason of the other.

Officers may roughly determine their opportunity for promotion under present law or under the proposed service since graduation scheme by reference to the table. For instance—a captain of the class of 1896 in his forty-eighth year of age on July 1, 1924, will retire, if not selected in the fiscal year, 1931. Therefore, the vacancies which occur in the fiscal year 1931 are the vacancies which will give this officer his opportunity. In that year flag officers who were fifty-seven years of age on July 1, 1924, will retire. This number is seven. The captain's competitors are his seniors who remain upon the list: namely, two officers of the class of 1894, five officers of the class of 1895 and such of the six officers remaining in his own class as are senior to him.

Under service-since-graduation the same number of vacancies would occur in the captain's thirty-fifth year of service, and his competitors would be the eleven officers in his own class.

Generally speaking casualties among seniors do not benefit any officer unless they occur in the year of the officer's opportunity.

Similarly, the opportunity of a commander under age-in-grade will depend first upon the number of vacancies caused by the promotion or retirement of captains in the group six years his senior

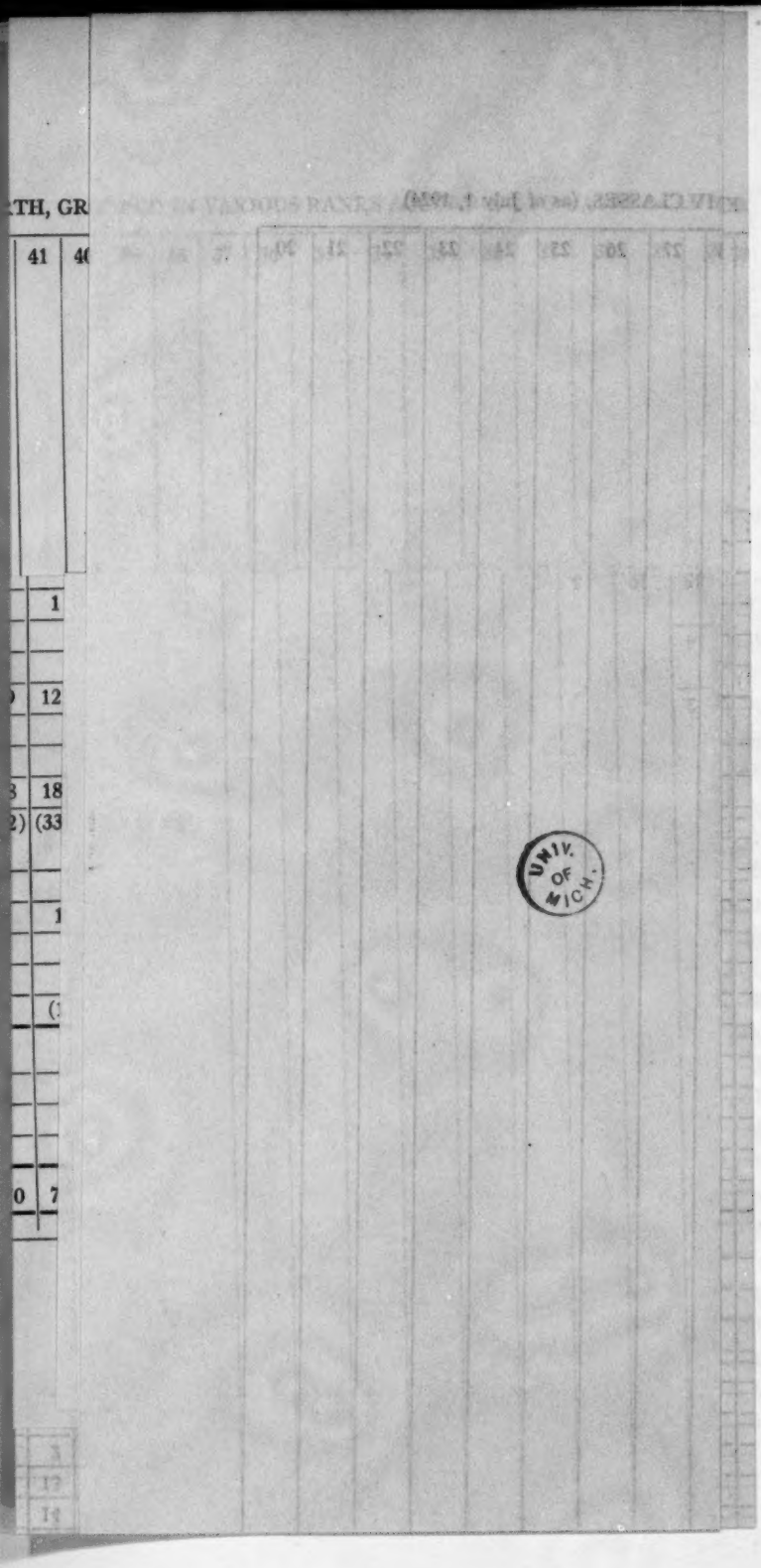
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TABLE SHOWING AGES OF LINE OFFICERS, FOR FISCAL YEAR 1925, COMPUTED FROM FISCAL YEAR AT DA

Rank	Yr. ser.	Class of	No.	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44
R. Adm.	44	1880	2	2																			
	43	1881	1	1																			
	42	1882	1	1																			
	41	1883	1		1																		
	40	1884	7			2	5																
	39	1885	3		1		1	1															
	38	1886	1						1														
	37	1887	7					1	2	2	2												
	36	1888	4							3	1												
	35	1889	10							2	3	2	3										
	34	1890	11									7	4										
	33	1891	6										2	3	1								
		Total R. Adm.	(54)	(4)	(2)	(2)	(6)	(2)	(3)	(7)	(6)	(9)	(9)	(3)	(1)								
Capt.	36	1888	1									1											
	35	1889	2										2										
	34	1890	1										1										
	33	1891	12									1	5	5	1								
	32	1892	12											5	3	4							
	31	1893	9									1	1		3	2	2						
	30	1894	14											2	1	4	5	1	1				
	29	1895	12													1	6	3	2				
	28	1896	11														4	2	4	1			
	27	1897	19														4	5	4	4	2		
	26	1898	17															2	7	5	1	1	1
	25	1899	27																4	14	5	2	2
	24	1900	34																2	8	9	9	5
	23	1901	30																		9	5	8
	22	1902	10																			2	3
		Total Capt.	(211)									(3)	(9)	(12)	(8)	(11)	(21)	(13)	(24)	(32)	(26)	(19)	(19
Comdr.	28	1896	2															1		1			
	27	1897	1																	1			
	26	1898	3															1	2				
	25	1899	1																	1			
	24	1900	3																	1			1
	23	1901	4																			3	1
	22	1902	21																			8	5
	21	1903	31																				8
		Ex-Warrant	4															1	1	1	1		
	20	1904	31																				
	19	1905	64																				
	18	1906	73																				
	17	1907	125																				
	16	1908	10																				
		Total Comdr.	(373)															(3)	(3)	(5)	(1)	(11)	(15
Lt. Cdr.	22	1902	1																				
	21	1903	1																				
	20	1904	3																				
	19	1905	3																				
	18	1906	7																				
	17	1907	4																				
	16	1908	100																				
		Ex-Warrant	1																				
	15	1909	108																				
	14	1910	80																				
	13	1911	124																				
	12	1912	111																				
		Ex-Warrant	1																				

DATE OF BIRTH, GROUPED IN VARIOUS RANKS ACCORDING TO NAVAL ACADEMY CLASSES, (as of July 1, 1924)

44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24	23	22	21	20
1																								
2																								
5	1																							
8	5	3																						
3	2	2	1																					
(19)	(8)	(5)	(1)																					
1	1																							
1																								
5	5	3																						
8	9	8	6																					
	8	7	4	9	2		1																	
	2	21	14	16	8	2	1																	
			13	25	16	15	4																	
			2	35	37	26	20	5																
					3		5	2																
(15)	(25)	(39)	(39)	)85)	(66)	(43)	(31)	(7)																
		1																						
			1																					
	2			1																				
			1	2																				
		2	1	1	3																			
			1	1	2																			
				6	40	26	19	9																
	1																							
					5	31	32	24	16															
						7	22	21	22	8														
							6	33	29	40	16													
								4	32	33	31	10	1											
	1																							

Comdr.	28	1896	2														1		1				
	27	1897	1																1				
	26	1898	3														1	2					
	25	1899	1																1				
	24	1900	3																1				1
	23	1901	4																		3	1	
	22	1902	21																		8	5	
	21	1903	31																			8	
		Ex-Warrant	4														1	1	1	1			
	20	1904	31																				
	19	1905	64																				
	18	1906	73																				
	17	1907	125																				
	16	1908	10																				
		Total Comdr.	(373)														(3)	(3)	(5)	(1)	(11)	(15)	
Lt. Cdr.	22	1902	1																				
	21	1903	1																				
	20	1904	3																				
	19	1905	3																				
	18	1906	7																				
	17	1907	4																				
	16	1908	100																				
		Ex-Warrant	1																				
	15	1909	108																				
	14	1910	80																				
	13	1911	124																				
	12	1912	111																				
		Ex-Warrant	1																				
	11	1913	90																				
	10	1914	5																				
		Ex-Warrant	5																		1	3	
		Total Lt. Cdr.	(644)																		(1)	(3)	
Lieut.	11	1913	1																				
	10	1914	91																				
		Ex-Warrant	4																				
	9	1915	102																				
		Ex-Warrant	5																				
	8	1916	115																				
		Ex-Warrant	5																				
	7	1917	169																				
		Ex-Warrant	5																				
		Acting Ensign	1																				
	7	1918 (Grad. 1917)	101																				
		Ex-Tempo. & Res.	341	2	1	1	2	7	4	3	8	6	6	6	4	11	10	11	12	12	11	8	6
		Acting Ensign	6																				
	6	1919 (Grad. 1918)	147																				
		Ex-Tempo. & Res.	264											1						1	2	4	4
		Total Lieut.	(1357)	(2)	(1)	(1)	(2)	(7)	(4)	(3)	(8)	(6)	(6)	(7)	(4)	(11)	(10)	(11)	(12)	(13)	(13)	(12)	(10)
Lt. (jg)		Ex-Tempo. & Res.	164																			1	
	5	1920 (Grad. 1919)	333																				
		Ex-Tempo. & Res.	89																				
	4	1921 (½ Grad. 1920)	215																				
	3	1921 (½ Grad. 1921)	216																				
		Total Lt. (jg)	(1017)																			(1)	
Ensign	2	1922	355																				
	1	1923	356																				
	0	1924	409																				
		Total Ensign	(1120)																				
		GRAND TOTAL	4776	6	3	3	8	9	7	10	14	18	24	22	13	22	31	27	39	50	40	44	47

1	1																							
1																								
5	5	3																						
8	9	8	6																					
	8	7	4	9	2		1																	
	2	21	14	16	8	2	1																	
			13	25	16	15	4																	
			2	35	37	26	20	5																
					3		5	2																
(15)	(25)	(39)	(39)	)85)	(66)	(43)	(31)	(7)																
		1																						
			1																					
	2			1																				
			1	2																				
		2	1	1	3																			
			1	1	2																			
				6	40	26	19	9																
	1																							
					5	31	32	24	16															
						7	22	21	22	8														
							6	33	29	40	16													
								4	32	33	31	10	1											
	1																							
									5	28	22	27	8											
												1	2	2										
3		1																						
(3)	(4)	(4)	(4)	(11)	(50)	(64)	(79)	(91)	(104)	(109)	(69)	(38)	(11)	(2)										
												1												
										2	36	33	13	7										
	1	1		1		1																		
											5	30	35	17	13	2								
		4			1																			
												3	32	37	29	14								
			2	1	1		1																	
													9	37	56	45	19	3						
			1	1		3																		
												1												
														12	27	35	15	11	1					
6	9	9	12	16	13	16	17	14	16	12	13	16	12	8	7	12	4	4						
															1	2	3							
															8	53	44	33	9					
4	4	8	18	13	16	18	10	15	21	21	10	16	26	13	17	20	2	3	1					
(10)	(14)	(22)	(33)	(32)	(31)	(38)	(28)	(29)	(37)	(35)	(64)	(100)	(127)	(131)	(158)	(183)	(87)	(54)	(11)					
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			(1)	(1)		(1)	(8)	(10)	(15)	(13)	(14)	(15)	(23)	(21)	(28)	(58)	(171)	(268)	(203)	(112)	(49)	(5)		
																	1	21	114	104	78	35	2	
																		1	27	95	109	88	36	
																			7	67	121	125	77	12
																	(1)	(22)	(148)	(266)	(308)	(248)	(115)	(12)
47	51	70	78	129	147	146	146	137	156	157	147	153	161	154	186	241	259	344	362	378	357	253	115	12

in age. His individual chance will then depend upon his seniority position.

Under service-since-graduation the class of captains which graduated from the Naval Academy seven years prior to the time that the commanders' class graduated will furnish the number of vacancies for which the commanders' class will compete in the twenty-seventh year of service of that class.

It is easy to determine the number of vacancies which must occur within a period of years. For instance, by 1932 all captains who, on July 1, 1924, were forty-eight years of age and over, will have disappeared from the list. This number is seventy-seven. That is, all such captains must have been promoted to rear admiral or retired by July 1, 1932.

LIMITATIONS OF AIRCRAFT IN NAVAL WARFARE

By Lieutenant Commander Sidney Ballou, U.S.N.R.F.

WITH an adequate air service one of our greatest present day necessities, it may seem inadvisable, as well as ungracious, to emphasize the limitations of aircraft. Unfortunately, however, aircraft enthusiasts have not contended themselves with constructive argument as to the value of this new instrument of warfare, but are preaching the doctrine that old and tried instruments may be dispensed with, particularly if they are expensive, and that the national defense may largely, if not wholly, be entrusted to the new and cheaper arm. A brief catalog of some of the limitations to which aircraft are subject may therefore tend to a saner, if less sensational, view of the probability of their fulfilling all the expectations claimed by their protagonists.

In the destructive side of aircraft propaganda it is noteworthy that the Navy is signalled out for attack. An anchored battleship, with no means of defense, is sunk after a day's bombing and the word goes out at once that the battleship is obselete. An entire brigade of infantry, represented in dummy form, could, under the same conditions, be wiped out in less time, but this experiment is never tried and no one rushes into print with the proposition that the infantryman is obsolete. There is an utter lack of contention that no more of the taxpayers' money should be spent on field guns and tanks, so easily wiped out by a single bomb from the elusive airplane.

One might think that this failure to enthuse over the destructive power of aircraft against land forces was due to the fact that there are too many men alive who have seen it tried under actual service conditions. This cannot be the explanation, however, for the achievements of airplanes on land, little as they tended to prove aircraft more than a strong auxiliary arm, were over-

whelming in comparison to the infinitesimal damage done by airplanes to ships. So far from getting any comfort out of naval experience during the war the aircraft exponents are driven at the outset to throwing overboard all war history and to depending wholly on postwar developments in aviation to form the basis which war experience refuses to supply.

Whatever may be the reason, it is certain that those who conceive it their duty to exalt the air service at the expense of the other branches are busy pulling down the Navy and not the Army. It is with relation to naval warfare that they hope to convince the country that old principles are obsolete, that old arms should be scrapped and that the air service should rise triumphant above the scrap heap. It is with relation to naval warfare, therefore, that some of the limitations of aircraft will be examined.

Sea Power.—Sea power being the force to be conquered and supplanted, let us attempt to visualize sea power by a concrete example. Within a few months from the outbreak of the World War every German raider had been driven from the ocean, a period of time likely to be lessened as the use of wireless on merchantmen becomes universal. For four years the Seven Seas were highways for the Allies and the Allies alone. Ships were bringing rubber from Singapore, nitrates from Chile, wheat from the Argentine, and above all, supplies, munitions and afterwards the decisive troops from America. Germany was getting nothing except what was available by way of her land communications, one closed sea and two perilous trips of a cargo submarine. All this was possible because at Scapa Flow, 500 miles from the nearest German port, lay a fleet of battleships of such strength that the German Navy dared not force it to decisive action.

Sea power is itself but an auxiliary arm. Its own guns can range but a short distance inland. Its sole function is to assure supplies and communications over the high seas to its possessors and to deny them to the enemy. Nevertheless, so vital are supplies and communications to armies and so necessary to them are the highways of the sea that sea power is usually the decisive factor in great wars.

It will be observed that the control of seas is not in proportion to the strength of the rival navies. Because the fleets are in proportion of sixty to forty does not mean that the superior fleet

commands sixty per cent of the waters of the earth and the inferior fleet forty. The portion of the superior fleet is the entire ocean, that of the inferior fleet is zero.

Radius of Action.—Against sea power, thus holding dominion over the Seven Seas, it is now proposed to launch air power. From what point? The trade routes of the earth were bearing assistance to the Allies, but not the most imaginative can envisage improved airplanes leaving Germany to seize and hold the trade routes of the earth. Even the most important route, the ocean lane from Hoboken to Brest or Bordeaux, over which troops and supplies were pouring, is as much beyond the radius of action of any postwar plane based on Germany as it was out of reach during the war. If planes improve it is only necessary to shift terminals and make the land route a little longer. We could have landed at Marseilles if necessary.

If it is proposed to strike directly at the heart of sea power, at the battleship fleet whose existence is paralyzing surface operations, the same weakness is manifest. In holding the seas, the main fleet of heavy ships is not obliged to lie within the striking distance of airplanes based on an enemy port. Blockaders have already been driven back by the threat of torpedo craft, and may be driven back further, but wireless communication more than compensates for the distance. The blockade of the next war will be a further extension of the elastic blockade, based on light craft inshore with heavier ships within supporting distance.

Briefly, then, aircraft are too limited in radius of action to wage successful war on sea power. The theater of operations is too large. A battle fleet radiates lines of power from its position like the queen on a chessboard. It can check from the opposite side of the board. A knight can attack and even capture a queen without danger to itself if it can get near enough and in the right position, but when a knight is proved to be stronger than a queen, then an airplane will be stronger than a battleship.

Aircraft Carriers.—It is to remedy the fatal lack of radius of action that planes are to be put aboard carriers. Now they can be brought to any vital point. The terminology of the argument shifts a little, for now the potency of sea power is admitted, but it is to be exercised by a different type of capital ship. Old principles are to remain unaltered, except for the contention that

a ship armed with bombing and torpedo planes is superior to one armed with 16-inch guns. Before two such ships are placed in tactical contact, however, there are numerous complications to be discussed.

The first limitation on aircraft carriers is artificial, but it is none the less real. They are limited by the Washington Treaty. Against our ultimate 525,000 tons of battleships, supported by 135,000 tons of carrier capacity of our own, the only carriers we have to figure on are 135,000 tons of Great Britain, 81,000 tons of Japan, and 60,000 tons each of France and Italy.

Aircraft carriers are neither cheap nor can they be built overnight—two of the arguments most stressed for aircraft. Differing radically in design from other types of vessels, they cannot be readily extemporized after war is declared, assuming that war would scrap the Washington Treaty. We are therefore driven to figuring whether our fleet of eighteen battleships, with its 192 big guns, supported by our own carrier capacity of 135,000 tons, is rendered obsolete and should be allowed to deteriorate by reason of the aircraft which can be carried upon say three Japanese carriers of 27,000 tons each. Anyone supporting this thesis should do some convincing figuring for the public.

Carriers as Surface Craft.—In estimating the value of carriers as supplying the essential radius of action, we are not, however, obliged to rely wholly upon the limitations of the Washington Treaty. An aircraft carrier is a surface vessel, and when we have put our aircraft force aboard we have subjected it to all the limitations of surface craft. Imagination, like the planes, must come down from the air, for now we are again on the charted seas of experience.

As a surface vessel the carrier has no more power than a cruiser, and it is against cruisers, not capital ships, that she would have to battle her way to the point where she could strike at the battle fleet. There is no more reason why she should not get there than the destroyer, the submarine or any other type of vessel that for the past thirty years has been trying to put the battleship out of business.

A variation on the idea of putting airplanes on carriers has recently appeared in the assertion that it will soon be possible to refuel airplanes from surface ships. The answer is the same.

We have only to remember as far back as the World War to know that there is one sure way to keep the enemy's surface ships off the ocean and that is to have an adequate navy. If any weight is to be given to this new possibility it merely emphasizes the necessity of a sufficient number of cruisers, for against cruisers, when properly supported by heavier ships, no surface craft can operate.

It may be difficult to show the average landsman just why a fleet of heavy battleships, properly supported by cruisers and other auxiliaries, denies the seas to all lighter surface craft, but this is too familiar ground to need recapitulation here. Experience is the best guide and the experience of the war is too conclusive and too recent to require much elaboration. Once admit that aircraft must be put on carriers to bring them into action, or that they must get their fuel supply from surface ships, and they have been relegated definitely to the spasmodic raiding activities of an inferior fleet.

Limited radius of action does not prevent aircraft from being powerful defensive weapons, but defense does not win wars, nor is it a substitute for sea power. The argument on this whole point may be tersely summarized in the proposition that an airplane cannot sink a battleship because it cannot carry enough fuel. Thus put it will be found to carry a new idea to the average aircraft advocate. Two questions will immediately arise; first, from what point did the airplane start, and second, how did it get to that starting point unmolested. By the time these are given some consideration it will be found that the average amateur has been thinking solely in terms of tactics, with the two opponents already in actual contact, and that the most elementary considerations of strategy and logistics have been wholly ignored.

Tactical Weakness.—Supplementing this important strategic limitation there is an almost equally important tactical weakness. The best defense against aircraft is aircraft. The defense against air attack will undoubtedly develop along the same lines as the defense against torpedo boat attack—that is, meeting kind with kind.

Battleships have anti-aircraft guns as they have anti-torpedo guns, but their first and most important line of defense will be their own aircraft, just as it is now their own torpedo craft.

Here, however, there is a line of divergence. When the torpedo boat was answered by the destroyer, it, in turn, became a destroyer, and attack and defense developed along parallel lines. There is no inherent reason why a destroyer attacking a battleship should be inferior to one designed for its defense.

With aircraft it is different. The attacking ship is a bombing or torpedo plane. Its enemy is the combat plane, particularly the single-seated pursuit plane. No development in aviation, past or future, can change the fundamental relation between these two types. The pursuit planes carried by a fleet for its protection will always be faster than the bombing and torpedo planes seeking its destruction.

Speed is not everything, but in every other military weapon lack of speed is made up by some compensating advantage. The submarine is slower than the destroyer it must evade, but it has invisibility. The battleship is slower than a cruiser, but besides its enormous destructive power, it is practically invulnerable to cruiser attack. The bombing plane alone is asked to take the air against an enemy which, so far as inherent quality goes, it is not strong enough to fight nor fast enough to evade.

So far as sea-going aircraft are concerned, that is aircraft which accompany the fleet, the bomber may reasonably count on being outnumbered as well as out-maneuvered. On a given carrier displacement it will usually be possible to put at least two pursuit planes as against one bomber. A fleet which elects to defend itself in the air instead of using its airforce for attack can therefore count on a substantial numerical superiority of defensive planes. In addition to those carried on the regular carriers, battleships and cruisers, while not adapted for carrying bombers, may add their quota of combat planes.

Under these circumstances, whatever may be the future developments of aviation, there is no reason to doubt that the defense will have no difficulty in keeping pace with any new form of attack from the air.

Weather.—Next to limited radius of action and inherent weakness of attack against defense, probably the most serious limitation of aircraft is the weather.

It would seem axiomatic that in sustained operations of war no commander can afford to place his main reliance upon any

force which is not available at any time and under all circumstances. He may employ auxiliary forces of a special kind, subject to special limitations, such as gas or smoke dependent on the direction and velocity of the wind. To adopt a major force of any such kind for attack is to limit attacking periods to an extent which necessity may not permit. To adopt it for defense is merely to invite the enemy to make his attack when such force is unavailable. Dependability is one of the most fundamental requisites of any military force.

The airplane is not a dependable weapon. Making every allowance for improvements in the past and in the future there remains a considerable percentage of weather during which it cannot fight. Not only severe storms but even ordinary cloud conditions frequently put it out of action.

We are all familiar with frequent postponements of flights and flying maneuvers in times of peace, when no unnecessary risks need be run, but few realize how materially air fighting is slowed up by weather in time of war. Most war narratives are diaries of achievement, with no mention of periods of inactivity, but any serious study of sustained operations shows up this defect in a striking manner. Take these extracts from the work of Admiral Sir Reginald Bacon on the Dover Patrol:

> Heavy gales and great quantities of rain were experienced during fourteen of the thirty-one days in December, 1915, and no flying was possible, while on others the conditions were such that while protective patrols were carried out over the warships off La Panne, it was not considered feasible to undertake offensive work.[1]
>
> A break in the weather called a halt in the continuous bombing attacks on both sides during the first two weeks of February, 1917, and, except for an occasional odd day, no flying operations were possible.[2]

So much for sustained operations. How easily ordinary weather on a summer day can put aircraft out of action may be judged from this random letter from the book of a British aviator:

> August 26, 1915.
>
> *Dear Dad:*
>
> What do you think of forty warships bombarding Zeebrugge? We were all due out there, of course, some spotting and fighters to protect the spotters. As luck would have it the weather was dud—clouds at 1,500

[1] Bacon, *The Dover Patrol,* Vol. 2, p. 230.

[2] *Ibid,* p. 255.

feet—with the result that no one got there, except a solitary fighter, and he was rewarded by a scrap with a German seaplane.

HAROLD ROSHER.[3]

As a prelude to the greatest of sea fights it is now well known that Admiral Scheer made elaborate plans, depending on preliminary observations by Zeppelins, that he was repeatedly disappointed by weather conditions and that the High Seas fleet finally went out without the necessary information at a time when the British fleet was actually at sea.[4]

If we have worked ourselves into the frame of mind where we believe that air control will decide the next war within forty-eight hours we may dismiss these considerations from discussion, but if we anticipate any continuous effort we must realize that any nation depending on aircraft for its primary weapon is under a severe handicap as compared with one which can do its fighting in all weathers.

One Point in Space.—Unlike any other military weapon the bombing airplane depends wholly on the force of gravity for the delivery of its projectile. It follows that, if its target is a single object and not an area, its attack must be made from what, without mathematical exactness, may fairly be described as one point in space. A torpedo plane, considering that it is not practicable to drop a torpedo more than fifteen feet without injury to its delicate mechanism, has not much more latitude.

During the entire time that an attacking plane of either type is within range of anti-aircraft guns it is in itself an impotent target, except for one brief moment at one definite and predictable point. From the moment it is sighted the path that it must traverse to reach its striking point is known. It is only necessary to put in that path a creeping or "ladder" barrage of bursting shells to make the odds against arriving rather heavy.

We hear considerable about the development of aircraft since the War, but not so much about the development of anti-aircraft weapons. As a matter of fact, some very efficient guns have been developed. We have machine guns with tracer ammunition visible up to 10,000 feet. We have a 3-inch semi-automatic, throwing shrapnel to an effective height of 21,000 feet and a 4.7-inch gun

[3] Rosher, *With the Flying Squadron*, p. 130.

[4] Scheer, *Germany's High Sea Fleet*, p. 135.

which can throw a 45-pound bursting shell higher than any bomber can climb. As we are now considering the limitations of aircraft rather than the strength of defensive measures, it is unnecessary to elaborate on the performance of these guns. The immediate point is that modern practice is not to aim at the airplane, which would be an elusive target, but to fill its predetermined path with bursting shells, which is taking advantage of a very definite weakness.

One Shot in the Locker.—When a bombing plane has battled its way against distance, against the weather, against faster pursuit planes and against anti-aircraft guns to the one point at the one moment at which it can deliver its blow, what has it to deliver? Without much exaggeration it can be said: one shot.

It is true that bombers can carry a number of small bombs, but these are not calculated to sink battleships nor even to penetrate armored decks. Airplanes that are risking their existence to mess up the upper works of a battleship are playing a game not worth the candle. It is likewise true that the heavier types of land bombers can carry several bombs of considerable size. As to these it is doubtful, as already stated, if battleships will be found within their range of flight, or whether a multiplicity of bombs will mean a multiplicity of shots in the sense that any corrections can be made for misses. So far as seagoing aircraft are concerned it is certain that any airplane that can be stowed on a carrier and take off in the length of a flying deck cannot be of a size sufficient to carry more than one torpedo or more than one bomb of a size sufficient seriously to injure a dreadnaught.

Now a military weapon that is out of action after firing one shot, or even one salvo, cannot be classed as an efficient weapon. It is fighting against the most persistent of enemies—the doctrine of mathematical chances.

No other weapon in practical use has this serious limitation. The naval gun, for example, has the most elaborate mathematical devices for finding the range and speed of the enemy and for solving the intricate problem of making curving shell and moving target arrive at the same point at the same instant. Yet with all this no battleship commander would consider it more than a lucky chance to be "on" with his first salvo. Coast defense guns have a stable platform and instruments of much greater pre-

cision than those possible afloat. Suppose we compile their target records for ten years to find what percentage of the first or "trial" shots landed on the target. Yet the airplane has only its trial shot, delivered from the most unstable of platforms at a moment to be determined from the factors of its exact altitude, its own speed and direction, speed and direction of target and wind velocity. One solution only, no corrections allowed.

Mental Hazard.—Airplanes, of course, have target practice and records of their own, but there is a notorious difference between practice and war performance. In the old days a duelling expert could break the stem of a wine glass at twenty paces but found it very different when the glass was replaced by a man with a pistol of his own. The present generation is more familiar with the example of a fullback kicking field goals with mathematical precision before the game and his relative performance when two opposing ends are charging down upon him.

A few weapons, like the bayonet and hand grenade, call for closer contact with the enemy, but no one but an aviator is called upon to make his final estimate and calculation under conditions of such hurried strain and such imminent peril to himself and his mission. If there is any sort of defense in the air he will not only be dodging a pursuit plane armed with a machine gun, but will be wondering whether he can get his bomb off before the next anti-aircraft burst will get him. With all the courage in the world and conceding that his anxiety is not for himself but for his success, these conditions are not going to make for accuracy in firing his one uncorrected shot.

Hit or miss, the airplane's usefulness practically ends when that one shot is fired. For that action at least, there is no reloading. Hasty retreat to a distant base is in order. In proportion to the effective force it can expend in one action, the airplane is probably the most expensive weapon devised.

Experience.—All this may seem hypercritical. The future alone can tell. In judging of the future, however, we may avail ourselves of the customary liberty of looking at the past.

As already indicated, the aircraft enthusiast is apt to dismiss all the experience of the World War with the observation that "aviation was in its infancy." We may fairly ask a more critical examination of the failure of air power to exercise any appre-

ciable effect on sea power, except as an auxiliary weapon whose effectiveness is not in dispute. Aviation has not changed in kind since the close of the war, only in degree, and if there was any indication of a beginning along the lines now under discussion its budding promise ought at least to be discernible. It is not.

The principal points which are relied on to support the contention that modern airships must not be judged by those of wartime is that the size and radius of action of airplanes have greatly increased and that they carry much heavier bombs. It happens, however, that Germany had, first and last, over fifty Zeppelins, and that no modern airplane has yet approached these in size, radius or weight of bombs. They proved vulnerable to weather, but as long as they lasted they should have shown what aircraft with plenty of radius and lifting power could do.

The first subject to challenge the attention of a military student is the failure of air power to close the line of communication between England and France. This was well within the radius of German aircraft. Zeppelins bombarded London but were utterly unable, in the slightest degree, to stop the flow of men and munitions across the English Channel. This artery was the most important sea lane of the entire war. "The British Navy," says Admiral Sims, "transported about 20,000,000 souls back and forth between England and France in four years, and in this great movement seaplanes, dirigibles and other forms of aircraft played an important part."[8]

Here we have a typical instance of sea power, aided by aircraft acting in an auxiliary and defensive capacity, holding open a line so vital that a month's closing would have meant the loss of the war. Against this line Germany threw her underseas weapon without serious effect. Why was her air power spent on inconclusive raids over the adjacent land areas instead of smashing this neck of the bottle with the conclusive ease with which paper air fleets are destroying paper surface fleets in every popular magazine of today?

Except for radius of action, which this sample is chosen to eliminate, the answer must lie in the limitations here discussed. We may speculate at will as to their relative importance, perhaps the

[8] Sims. *The Victory at Sea*, p. 323.

defensive aircraft, perhaps the uncertainties of weather, perhaps the effort needed to launch the meager number of missiles carried.

Certain it is that within practically the same theater of operations the Germans conducted air raids which were (a) intermittent; (b) at night when air defense could not readily gather; (c) in weather of their own choosing and hence merely occasional; (d) directed against large areas as targets. They failed utterly to solve a far more important problem calling for effort (a) continuous, (b) in daytime when defensive aircraft could see them, (c) in all weather in which surface craft could operate, and (d) with individual ships as targets. If this problem is not as inherently insolvable today as it was then, it behooves the airmen to come down from the clouds long enough to tell us wherein the difference lies.

Airship against Battleship.—Even upon the narrower issue of airship against battleship the utter failure of the airship under war conditions needs more explanation than has yet been forthcoming. It must be repeated that Germany's monopoly of Zeppelins gave her air fleet a backbone of fighting craft which in the matter of radius of action and weight of bombs were superior to present day airplanes. It must also be remembered that even with increased radius of action not all European apprehension need be shared nor all European practice followed by a nation still separated from possible enemies by 3,000 miles of water. The fact now to be pondered, however, is that Zeppelin and airplane alike inflicted no damage on capital ships and very little on other types, even within easy radius.

To one who has seen the chart of the North Sea "sweeps" of the Grand Fleet, such as now hangs in the cabin of the *Hood,* this fact is very striking. Apparently, no attention whatever was paid to the fact that they were often within easy reach of German air bases. As for cruisers and all lighter craft, the entire North Sea was theirs to the limits of the German mine fields off Heligoland and Horn Reef. With aircraft for observation and bombers galore the enemy allowed the British fleet to cruise with impunity within striking distance of their coast.

An individual instance of the failure of wartime experience to measure up to the roseate promises of today is that of the *Konigsberg.* When her raiding activities could no longer be maintained

this cruiser was marooned in a shallow river in German East Africa. Here she lay, as helpless as a target ship, with the one exception that she had her anti-aircraft guns. The British brought down two seaplanes to bomb her. In the face of the anti-aircraft fire they proved unequal to the task. After several attempts one of them crashed into the sea and was wrecked.[6] Then the Admiralty sent down two monitors, and with seaplanes spotting for the indirect fire—just the kind of auxiliary service which all admit is invaluable—the *Konigsberg* was quickly destroyed.[7]

Jutland.—The culmination of naval fighting was Jutland. If ever sea power needed effective air power to aid it, or if ever air power proposed to demonstrate the beginnings of an ultimate superiority, it was that day. Preliminary plans for Zeppelin observations had gone wrong, owing to unfavorable weather conditions. Admiral Scheer's "list of warships which took part in the battle of the Skagerrak and the operations connected therewith" includes ten Zeppelins. Five of them took the air when the British fleet was first sighted. Their achievements are briefly chronicled. "They took no part in the battle that so soon was to follow, neither did they see anything of their own main fleet, nor of the enemy, nor hear anything of the battle."[8]

The first mention of a Zeppelin by the British was at daybreak after the engagement. Jellicoe's battleships were off Horn Reef, as near the enemy's base as they dared to go on account of mine fields. A Zeppelin was sighted which reported the position of the British fleet to Scheer. Shortly afterwards, when Napier reported that he was engaging another Zeppelin with his cruisers, the British battle fleet, which the day before had turned away from destroyer attacks, went over and helped. The airship disappeared to the eastward and no molesting force came out to show what "control of the air" could accomplish.

At no time during the war did aircraft in touch with enemy fleets function to any degree such as we should now be led to expect. On August 18, 1916, Jellicoe notes: "Zeppelins were frequently in sight from both the battle and the battle cruiser fleet and were fired at, but they kept at too long a range for our fire

[6] Corbett, *Naval Operations*, Vol. 3, p. 8.
[7] *Ibid.*, p. 66.
[8] Scheer, *Germany's High Sea Fleet*, p. 141.

to be effective." The next day the commander of the Harwich force reported that "his force was shadowed by airships during the whole period of daylight on the nineteenth. . . . . It was evident that a very large force of airships was out."[9]

Offensive Operations.—Allied aircraft were by no means confined to defensive operations. The British had bombers and used them in naval operations. During 1917 Jellicoe reports persistent aerial attacks against vessels at German naval bases in Belgium, but the only victory claimed is that German destroyers found it so uncomfortable that they moved. The location of the German battleships in their harbor was perfectly well known and the whole North Sea was available for the launching of seaplanes on any calm day, but damage to capital ships there was none.

Meanwhile submarines were infesting British coastal waters and were hunted by aircraft as well as by every other kind of vessel. Well within range, observable even when submerged, vulnerable to small bombs and utterly helpless against aerial attack, the total bag to the credit of bombs from British aircraft was probably five.[10]

American Experience.—Yankee ingenuity and initiative brought no better results. Admiral Sims has an entire chapter on "Fighting Submarines from the Air," which is instructive reading. Extremely useful as auxiliaries to naval forces, invaluable for scouting and observation, there is not a suggestion that aircraft could be depended on to go out unaided to find the enemy and sink him with bombs.

Here is Admiral Sims' description of the work:

> At the cessation of hostilities we had a total of 500 planes of various descriptions actually in commission, a large number of which were in actual operation over the North Sea, the Irish Sea, the Bay of Biscay, and the Adriatic; our bombing planes were making frequent flights over enemy submarine bases and 2,500 officers and 22,000 enlisted men were making raids, doing patrols, bombing submarines, bombing enemy bases, taking photographs, making reconnaissance over enemy waters and engaging enemy aircraft.[11]

With all this activity American aircraft were credited with just one submarine destroyed by direct action and one "probably damaged" when Ensign Ives dropped a dud upon it. As Admiral Sims

[9] Jellicoe, *The Grand Fleet*, p. 436.
[10] Sims, *The Victory at Sea*, p. 320.
[11] Sims, *The Victory at Sea*, p. 333.

calls this latter "perhaps the most amazing hit made by any seaplane in the war" we need look no further for more material results.

The whole summary of war experience may be quoted from the same distinguished author:

> I have said that the destructive achievement of aircraft figure only moderately in the statistics of the war; this was because the greater part of their most valuable work was done in cooperation with war vessels.[12]

Which, so far as human prescience goes, will probably be as true tomorrow as it was yesterday.

Conclusion.—Neither in a careful estimate of present day conditions nor in the light of war experience with every allowance for improvements can we discover any warrant for the claim that the airship is likely to put the battleship out of business.

The fundamental reason goes back to the dawn of the history of warfare. The bombing airplane is by nature a raider, designed to deliver its blow and retire. It is, in fact, the most helpless of weapons after it has delivered its shot. By its nature it cannot hold a position once taken, and so is incapable of exercising that steady pressure by which wars are won.

Battleships can take and hold positions. Usually the position is one from which the inferior enemy fleet can be contained, after which cruisers can maintain all lines of communication. If necessary to cut an enemy line of communications a force able to hold its position must be stationed across it.

No raiding operations ever severed a line of sea communications. The French tried it for centuries with their commerce destroyers. The German submarine came near succeeding, largely through the novelty of the problem to be solved, but development of the defense, notably the depth bomb and the adoption of the convoy system, soon swung the balance. With all its relative disadvantages and special limitations of its own there is no reason to believe that the airplane will succeed where the submarine failed.

Wars, whether on land or sea, will be won in the future as they have been in the past by the comparatively slow but irresistible force which is able to move from one strategic position to another, take it, consolidate it, hold it, and move on the next. On land this force is the infantry, on sea it is the battleship. The airplane is not of this type.

[12] Sims, *The Victory at Sea*, p. 321.

THE GREAT PLANETARIUM OF THE GERMAN MUSEUM IN MUNICH

By Dr. Ing. W. Bauersfeld, *Jena*

(Translated by G. N. Saegmuller, Vice President, Bausch and Lomb Optical Company, Rochester, New York.)

PREFACE TO THE ARTICLE

The following article is a translation of a technical paper published in Vol. 68, No. 31 of the *Journal* of the Vereines Deutscher Ingenieure and is descriptive of an instrument known as the Planetarium, which projects images depicting the relative movements of the sun, of the moon, of the planets, and of the fixed stars on the inner surface of a hemispherical dome; in other words, it simulates, or rather demonstrates, the relative movements of the heavenly bodies and presents a vivid, realistic picture of all changes in the relative positions and relative movements of these bodies. The translation is the work of G. N. Saegmuller, vice president of the Bausch and Lomb Optical Company, and it is through his courtesy that I have been successful in obtaining the article for publication in the U. S. Naval Institute Proceedings. My interest was first aroused while in Europe during the summer of 1924, when on a brief visit to the Carl Zeiss Works at Jena, Germany, the builders of the instrument. While there I was fortunate in finding the Planetarium, described herein, set up and in operation preparatory to being disassembled and shipped to Munich. The instrument, in external appearance, reminded me very much of a gun director and its operation showed a beautiful mechanical solution of the problem of demonstrating simply, readily and in a very realistic manner, the relative movements of the heavenly bodies.

In view of the weight given to the study of navigation and of astronomy at the U. S. Naval Academy, it occurred to me that the translation of the original description of this instrument would

be of interest to the naval service, and it is, therefore, my desire to express appreciation to Mr. Saegmuller.

It is further of interest to know that the mounting of one of these instruments in Rochester, New York, is under contemplation. The writer is informed that the following instruments are building in Germany or under consideration:

1. Munich—The dome has an internal diameter of thirty-one feet approximately.
2. Jena—The dome has a diameter of fifty feet.
3. Berlin—The dome will have a diameter of sixty feet; it is understood that estimates for the building complete with the instrument approximate $125,000.
4. Dresden—The dome under consideration will have a diameter of eighty feet.

In permitting me the use of this article, the translator prefaced his work with the following remarks, which are of interest:

Planetariums or astrolabiums showing the relative motions of sun, moon and planets have been constructed at various times and are nothing new, but all were built on a small scale and the observer had to watch the various movements of the heavenly bodies from the *outside* of the apparatus. The new Zeiss Planetarium is of such construction that the observer is located on the inside of the apparatus and observes the motions of the heavenly bodies as they actually occur.

The ingenious idea of employing projection apparatus, and the fine solutions of the many difficult mechanical problems are due to Dr. Bauersfeld. He was, indeed, fortunate to have had the vast resources of the Carl Zeiss firm at his command; they again have demonstrated that they are leaders in scientific development, either in optical or mechanical directions.

HALLER BELT,
Formerly Lieutenant-Commander, U. S. Navy.

SOME time before the outbreak of the war Dr. Oskar von Miller, the director of the German National Museum at Munich, approached the Zeiss firm regarding the construction of a planetarium which would show the movement of the heavenly bodies according to the Ptolemaic system on the interior of a semicircle dome in the same manner as they appear in the heavens. The first idea which suggested itself was to represent the stars by small electric bulbs attached to the hemispherical dome which would have to be rotated around an axis

parallel to the earth's axis. Sun, moon and planets were to be represented by illuminated discs driven by suitable gearing in such a way that the epicycle orbits of the heavenly bodies would be truly represented. The movements were to be so rapid that the happenings of one year could, at will, be reduced to a few minutes. It soon became evident that it was impossible to solve the problem in this manner, and the outbreak of the war, of course, put a stop to the work. It was taken up again after its close, but the problem was attacked from an entirely different point of view and the solution is such that it will also interest those who are not interested in mechanical problems.

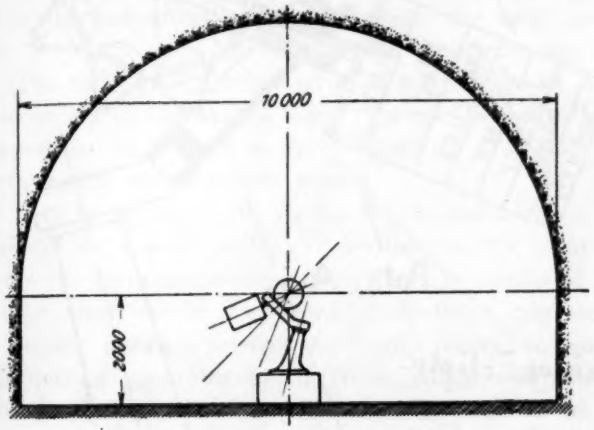


FIG. 1. DOME WITH PLANETARIUM

The basic idea of the solution was to have the hemispherical dome fixed and to throw the images of the heavenly bodies on the dome by means of a system of projection apparatus which naturally had to be placed as near as possible to the center of the dome.

The available space in the Munich Museum allowed only ten meters for the inside diameter of the dome, with the horizontal line (Fig. 1) two meters above the floor. The system of the projection apparatus is placed at the same height and moves with a velocity corresponding to the movement of the heavenly bodies.

It is comparatively easy to project the system of the fixed stars. In the center of a hollow brass ball of one half meter diameter

is placed a Nitra lamp of 200 watts which furnishes illumination for thirty-one projectors which are attached to the outside of this hollow ball and which are so placed that each one projects a part of the starry heavens (Fig. 2).

The diapositives for these star projectors were made photographically from drawings executed on a large scale which

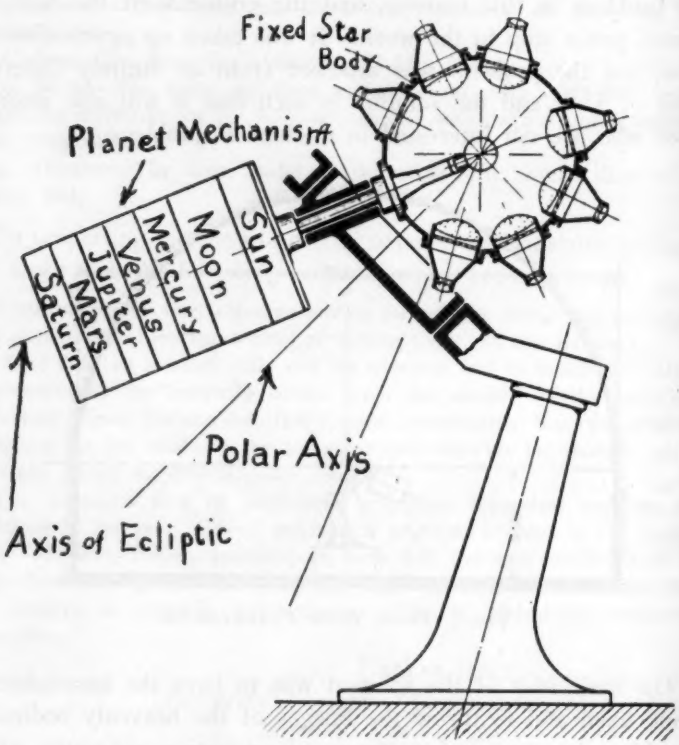


FIG. 2. ARRANGEMENT OF PLANETARIUM

showed every star up to the sixth magnitude. Four thousand five hundred stars were thus located, which is about the number visible to the naked eye. The different magnitudes were represented by discs of different size; thus a star of the first magnitude presents a disc of twenty-three milimeters diameter on the projection surface. This system of different sized discs has proven perfectly satisfactorily in practice and to the observer they appear as stars of different magnitude. To project the milky

way it was necessary to provide a number of small projectors with the diapositives more or less diffused; it was also necessary to have additional small projectors showing the names of the different constellations.

This hollow ball carrying all these projectors revolves around an axis parallel to the earth's axis, which, for the latitude of Munich, makes an angle of about 42° with the vertical.

It was much more difficult to produce the movement of the sun, moon and planets. To obtain the loop shaped orbits of the planets mechanically, even approximately, proved to be impracticable and resource was had to the simple Copernican theory of their movements to obtain their correct orbits. This solution is easily understood when we consider the fixed stars immovably projected on a sphere in whose center the sun is also fixed. The earth and planets move around the sun in elliptical orbits according to well known laws. The spot on which a planet is to appear in the heavens is the prolongation of the line from the earth to the planet to the sphere.

It is easy to represent the motion of the earth and a planet mechanically on a small scale. If we imagine the point which represents the earth connected with a planet by means of a telescopic tube which can be lengthened or shortened, corresponding to the varying distance between earth and planet, and attach a small projecting apparatus to this tube, which will throw the image of the planet in the direction of the tube's axis on the starry sphere, the problem is solved and the image of the planet must describe its path with great precision.

In order to prevent these projection apparatus from interfering with each other, it was necessary to arrange them serially, one behind the other. This necessitated the reproduction of the earth's orbit for each planet, also that the various mechanisms should be driven by individual axes of small diameter, in order not to cast too much of a shadow, as they could not be driven by a central axis for the reason that the above mentioned system of telescopic tubes had to move freely over the center of the orbits.

Fig. 3 represents the movement for Mercury. Two round metal discs "a" and "b" are held together at their circumference

by the studs "c" "c." The upper disc carries an axis which is inclined 7°, corresponding to the inclination of Mercury's orbit to the ecliptic (earth's orbit) and to this is attached a lever carrying a small steel ball representing Mercury. In a corresponding manner a small steel ball representing the earth is attached in correct radial proportion to a lever rotating on an axis secured to the lower disc.

These two balls, representing Mercury and the earth, are not connected by telescopic tubes mentioned above, but by a diagonal lever system (or movable parallelograms) which allows a greater range in the lengthening or shortening distance between the balls representing Mercury and the earth. At the end of this system the small projection apparatus is attached and its optical axis

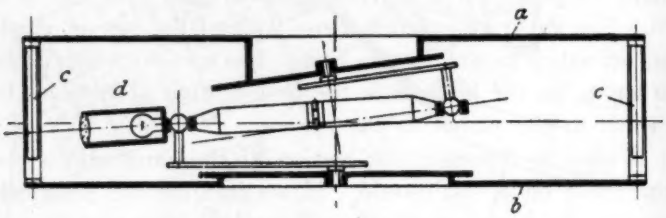


FIG. 3. PLANETARY MOVEMENT (MERCURY)

is always in line with the centers of earth and Mercury. This, however, is not strictly true as the planetary movement had to be moved slightly away from the center, due to the fact that the fixed star apparatus already occupied this position as shown in Fig. 2. On this account, the projectors are inclined a certain amount from the true position.

The planetary orbit as shown in Fig. 3 describes a circle with the sun in its center. This is not strictly correct as these orbits are really ellipses, but the differences in planetary orbits between circles and ellipses are very slight; the greatest difference is found in the orbit of Mercury where the small axis of the ellipse is two per cent smaller than the great one. This difference would not amount to very much, but the error would become far greater if the variations in the velocity in different parts of the orbit were not taken into account. To diminish

this error, a crank movement is being made use of based on the following considerations:

Fig. 4 depicts the ellipse of the orbit of a planet "P" with "S" as the sun in one of its foci. If we commence with the point "A" which corresponds to the shortest distance from the sun (perihel) and calculate the angles φ which the radius vector describes in the time "t," the relation between "t" and φ can be expressed by the formula

$$2\pi\frac{t}{T}=\varphi-2\,\epsilon\sin\varphi$$

"T" represents the full revolution in time, "ϵ" the numerical eccentricity of the ellipse as given by the proportions of the distances "MS" to "MA."

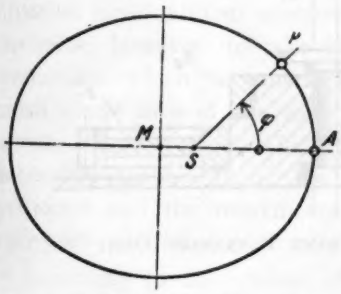


FIG. 4. PLANETARY ORBIT

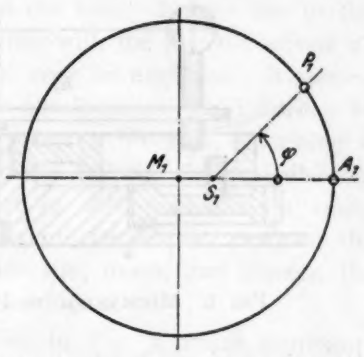


FIG. 5. APPROXIMATE ORBIT OF PLANET

A very similar formula is obtained if we consider a point "P_1" (Fig. 5) to move with perfectly uniform motion over a circle. The radius vector of an eccentrically located point "S" gives the angular valve φ dependent on the time "t" very closely according to the formula

$$2\pi\frac{t}{T}=\varphi-\epsilon_1\sin\varphi$$

ϵ_1 expresses the proportion of the distances "M_1 S_1" to M_1 A_1. It is very easy to effect this mechanically if we substitute $\epsilon_1 = 2\,\epsilon$ (as evidenced by comparing the two formulæ) and we receive approximately the movement of the radius vector

of the elliptic orbit. Without great error the elliptic motion of the planet may be assumed to be circular, taking care, however, that the position of the sun conforms to the numerical eccentricity of the real elliptic orbit.

This circular orbit is produced by means of a crank, and the crank pin, which represents the planet, receives its motion from the crank arm "S_1 P_1" (Fig. 5). This is embodied in the mechanism sketched in Fig. 6.

The pin "p" at the end of the crank "h_1" represents the planet and the motion is produced by means of a slotted lever "h_2" which itself is moved by pin "p_1" attached to the wheel "Z." This wheel "Z" receives a uniform motion by means of gears whose axes are placed outside the discs "a" and "b" (Fig. 3)

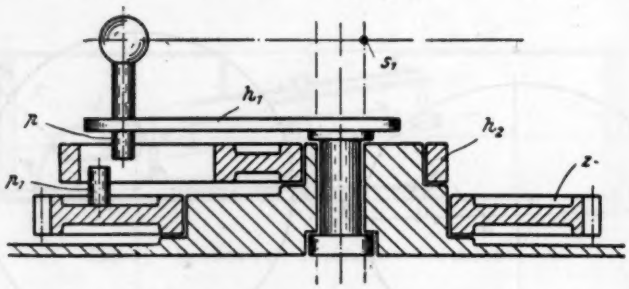


FIG. 6. MECHANISM TO PRODUCE PLANETARY ORBIT

along the various planetary movements. The lever "h_2" represents the radius vector "S_1 P_1" in Fig. 5. The intersection "S_1" of its axis with the plane of the circle produced by the planet ball on lever "h_1" represents the sun's position. The drive pin of the three members "h_1 h_2" and "Z" in Fig. 6 are, as a result of the reasons given above, placed excentrically in relation to each other.

In spite of the introduction of this movement considerable errors still remain in the orbit of Mercury on account of its great excentricity of 0.2. The angular errors φ of the radius vector (Fig. 4) vary from $-3.9°$ up to $+3.9°$ which in the most unfavorable position of Mercury, at its nearest approach to the earth, amount to about 7°. Without the use of the above described correction mechanism the errors would amount to $\pm 19°$ in the projected

position of Mercury on the sphere. The position errors of the other planets are much smaller on account of the smaller excentricity of their orbits. Mars, which has, next to Mercury, the greatest excentricity, shows errors of only about one fifth of those of Mercury.

The orientation of the various planetary movements and the moon's path had to be considered in relation to the ecliptic, the position of which, in regard to the fixed stars, could be considered as fixed. This resulted in the arrangement of these various mechanisms around an axis which represents the axis of the ecliptic and which has a fixed relation to the fixed star sphere (Fig. 2). The axis of the ecliptic forms an angle of $\pm 23.5°$ with the polar axis and the small changes due to the changes of this inclination, together with the periodic effects of nutation could without appreciable error be neglected. It seemed desirable, however, to take into consideration the influence of precession which is caused by the earth's axis describing a small circle around the axis of the ecliptic, the period being about 26,000 years. The effect of this precession is easily accounted for by giving the axis of the ecliptic, carrying the projector and the movements for sun, moon, and planets, the necessary additional movement, see Fig. 2.

According to the scheme shown in Fig. 3, which represents Mercury, similar mechanisms were designed for each planet and encased in circular boxes all of them connected and arranged as shown in Fig. 2.

Close to the lower bearing of the axis of the ecliptic the sun's projector is placed whose movement is readily effected as the sun is represented by a fixed central stud and only the earth's motion had to be taken into account.

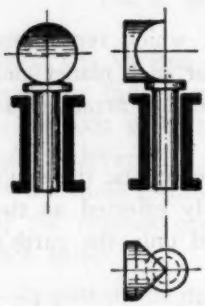
The movement next to the sun represents the moon and here the earth can be represented by a fixed stud. The movement of the moon presents many difficulties. Whereas the orbits of the planets can be represented without appreciable error as fixed in relation to the fixed stars, the moon's orbit changes rapidly. Its inclination to the ecliptic is a little more than 5°, which can easily be represented by inclining the central axis of the moon's orbit to that extent just as shown in Fig. 3 for Mercury. The

small changes in the inclination of the moon's orbit can be overlooked as they occur periodically.

But the line of intersection of the moon's orbit with the ecliptic changes so rapidly that a full revolution is completed in 18.6 years. This change has been taken care of by giving the inclined central axis an additional amount of motion around the axis of the ecliptic. A further complication arises from the fact that the direction of the great axis of the moon's orbit changes every year about 40°. To represent this change mechanically would have complicated the mechanism and the necessary gearings. For this reason it was deemed best to assume the moon's orbit to be circular instead of being elliptic since the small amount of eccentricity of 0.055 causes an error of only about 6° in the projected moon's position.

To represent the phases of the moon the simplest solution seemed to be to employ a small electric bulb with one-half of its surface blackened, and to throw its image directly on the sphere.

It is evident that the turning of the lamp would show the moon's phases, but it was found that the bulbs could not be made small enough and that the required brightness could not be obtained.



FIGS. 7 TO 9

The problem was solved by placing back of the diaphragm in the projector which represents the full moon, an additional diaphragm having the forms shown in Figs. 7-9. This works very well from one full moon's phase to the next, but by continuing rotation the real phases would not appear but their reflected images. To obtain the correct phases it would have been necessary to advance the diaphragm 180° at once at full moon time, and this not being feasible it was thought best to employ a second projector rigidly connected with the first one which alternately comes into action. By this means it was possible to obtain uniform motion for the diaphragms producing the phases.

Next to the apparatus representing the motion of the moon are placed the projection mechanisms for the planets Mercury, Ve-

nus, Mars, Jupiter and Saturn, which are all constructed on the same general plan as already described for Mercury. The phases of Venus were not taken into consideration as they are not visible to the naked eye.

To revolve the entire planetarium two possibilities had to be considered. To represent the daily motions the entire system has to revolve around the polar axis, which is effected by means of an electric motor attached to the side of the main column of the planetarium. By means of change gears different velocities can be obtained and a day can be represented in four and one half minutes, two minutes, or fifty seconds. All other movements are rigidly connected with the polar axis by gearing. The movements of sun, moon or planets relative to the fixed stars are, of course, very slow. To make these movements more perceptible it is necessary to throw the polar axis out of gear which makes it possible to show the movements of the planets relatively to the fixed stars, which are now at a standstill, by imparting more rapid motion to their mechanism by means of an auxiliary motor, which by means of gears is directly connected with the main axis of the planetary movements. Three velocities are provided and the happenings of a year can be shown in four and one half minutes, fifty or seven seconds. This last speed is primarily for the purpose of being able to set the position of the stars for a particular time. Reverse motion is also provided.

By using this yearly motion the loop shaped orbits of the planets are beautifully represented. As a matter of course the fixed stars do not strictly stand still, as on account of precession a small movement is given the axis of the ecliptic.

All mechanisms are rigidly connected by means of gears (excepting the daily motion which can be disconnected). A revolution counter on the planet axis permits setting it to any particular time. The accuracy of these movements over long periods of time depends, of course, on the proper selection of gears which are necessary to produce the motions of sun, moon and planets. It would have been very easy to produce the utmost accuracy if the size of gears did not have to be considered. As, however, a limit to these dimensions had to be set, it was merely a question of patience to select such numbers for the teeth of the

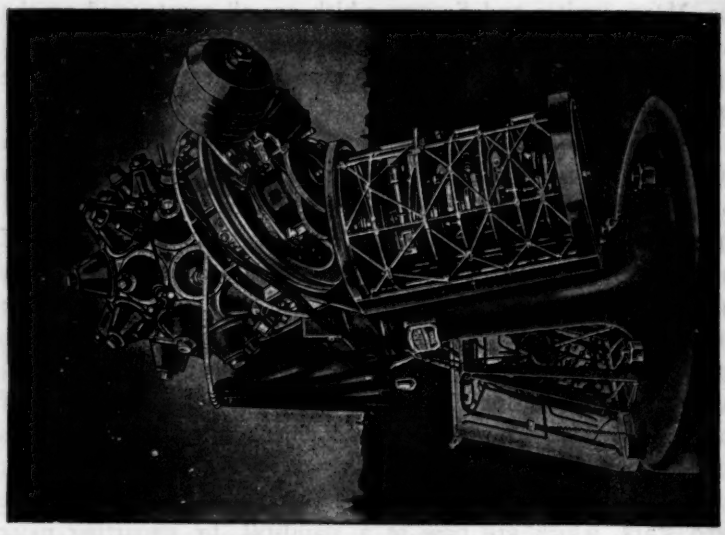


FIG. 11

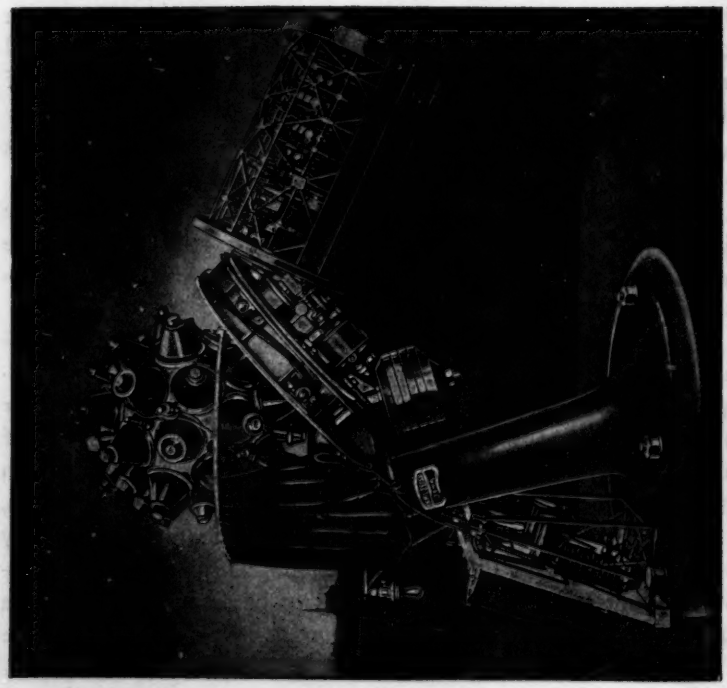


FIG. 10

various gears as finally gave the nearest result to absolute accuracy.

For example, the data for Mercury may be given. For the main driving axis common to all planets ten revolutions were taken for one sidereal year; thus for the movement of the sun a proportion of 1 : 10 resulted. The astronomical data for Mercury gave the proportion 0.415209106, which can very well be represented by the fraction $\frac{3^2 \times 11 \times 43}{2 \times 7 \times 13^3}$ with a remaining error of $1 : 10^7$. This error is so small that for Mercury an error in position of 1° would not occur before a lapse of 5,000 years.

Regarding the other planets and the moon the errors for the same space of time are considerably less without making use of additional gears.

Although a great number of gears are necessary to drive all these mechanisms the friction has been reduced to a minimum by the use of ball bearings wherever it was possible to employ them.

Figures 10 and 11 show the planetarium in high and low position of ecliptic.

On the side of the main column the switchboard is seen by means of which all projectors and motors are manipulated.

In the background the Munich horizon is shown as it appears from the platform of the National Museum.

In demonstrating the daily motions it would have been necessary to produce such a bright illumination at the rising of the sun that the stars would disappear. This was not done as it seemed more important to show the movement of the sun through the various constellations and the movements of the planets in its proximity.

A very effective demonstration of the movement of the heavenly bodies is obtained by throwing in gear both the daily and yearly motions in such a ratio that the sun retains its position on the meridian. The effect is the same which an observer on the earth would obtain if the earth always presented the same side to the sun, as is the case of the moon in regard to the earth. In this case the orbits of the inner planets (Mercury and Venus) appear clearly as ellipses while the outer

FIG. 11

FIG. 10

planets move through the entire Zodiac without forming loops. The sun does not remain fixed but performs a periodic movement up and down on account of its varying declination throughout the year.

The reproduction of the firmament by means of the described projectors is very effective and charming from an aesthetic point of view as the smooth spherelike projection surface destroys the faculty of differentiating distances and produces in the observer the impression of infinity. Another illusion is produced when the fixed starry heaven is moved around the polar axis; the observer is apt to imagine that the floor is moving around and that the heavens remain firm.

The planetarium was first shown in Munich at the annual meeting of the National Museum in the fall of 1923, the apparatus being far enough advanced to produce the projections. The numerous exhibitions proved that the complicated mechanism stood the trial exceedingly well although it revolved apparently several thousand years.

With this apparatus the firm of Carl Zeiss has produced a very effective means of furthering the knowledge of the movement of heavenly bodies and awakening an interest in astronomy.

The cost of constructing such a planetarium is necessarily high, but not so prohibitive that they could not be erected in large cities, especially if a small entrance fee were to be collected. The usefulness of such an apparatus for instruction in schools can not be overestimated.

A second planetarium with a dome of sixteen meters inside diameter is being built, to be erected on the grounds of the Zeiss factory. This new apparatus will have some additional features not possessed by the one erected in Munich.

For instance, the polar axis may be made adjustable in latitude, which would make it possible to produce the heavenly motions as they appear to an observer at the north pole or the equator. The phenomena of the midnight sun can also be produced very effectively.

SPALATO, 1919

By Lieutenant Commander Richard Stockton Field, U.S.N.

IF THE story of the American Navy at Spalato were written in the form of a play it would have the following cast:

Rear Admiral Niblack
Rear Admiral Andrews and
Captain Boyd, of the United States Navy
Vice Admiral Millo
Rear Admiral Rombo and
Commander Menini, of the Royal Italian Navy
Dr. Ivo Krstelj, President of Provincial Government of Dalmatia
Major General Wasic
Major General Milic
Lieutenant Colonel Plesnicar, of the Royal Serbian Army
Dr. Dubokovic, Dalmatian Secretary of Commerce
Mr. Stepanovic, Captain of the Port of Spalato
Dr. Ivacic, Chief of Police of Spalato
Professor Roko Misetic, General Assistant and Interpreter Extraordinary

Officers and bluejackets of four navies, Serbian soldiers, Italian and Jugo-Slav elements of the local population, the brightly dressed peasants, the picturesque Dalmatian boatmen, the flock of unowned and uncared-for war orphans; these would form the colorful background.

Dalmatia became a part of the Roman Empire about 30 B. C. Toward the middle of the third century after Christ there was born in that province a man who became Diocletian, one of Rome's greatest rulers. Diocletian chose to pass his last days on his native soil and, while he was still emperor, he caused to be built on the shore near his birth place a great palace. That palace is standing in remarkable preservation today; it forms the heart of Spalato, the city that grew up around it. The older Roman town of Salona is four miles away. Several authorities state that the palace gave the name to the town; that Spalato is a contraction of Salona Palatium. While other writers dispute this derivation, no one offers a more logical or more pleasing suggestion.

The town of today fills and encloses the old palace. Within its walls are hovels and luxurious apartments, city jails and movie

palaces, all using part of the original walls and pavements. A large part of the original south front is still visible from the sea. The beautiful Porta Aurea, on the northern side, is intact except for some columns which were taken away by the Venetians. The central court, or peristylium, is marvelous in its preservation after 1,600 years.

With the decline of the Roman Empire Dalmatia passed, in the sixth century, under Byzantine control and from then until 1102 its destiny was linked with that of Constantinople. The Slavonians occupied the country in the seventh century. They settled mostly

Photo Wayne

AN ELEMENT OF THE INTERNATIONAL PATROL, SPALATO, 1919

in the rural districts and did not displace, to any extent, the Latins in the coast towns.

History states that from 1102 until 1420 Dalmatia was claimed by both Venice and Hungary, and that, in 1420, it definitely became part of the Venetian Republic. In 1520 the greater part of Dalmatia was captured by the Turks but the maritime towns remained under Venetian control. Spalato was spared the occupation of the Turks although Clissa, the outpost of the moslems, was in plain sight of the town. The Dalmatians have always been able sailors. They furnished a squadron which took an important part in the victory over the Turkish fleet at Lepanto in 1571.

In 1699 the whole of Dalmatia was regained by Venice. In 1798 it became a province of Austria-Hungary. From 1807 until

1814 it belonged to France, though during this period a Russian expedition landed at Cattaro and occupied a large part of the province. In 1814 it went back to form part of the Austro-Hungarian Empire and so remained until the latter part of 1918.

Before the late war Austria-Hungary included that coast of the Adriatic from a point a few miles west of Trieste all the way down the shore to Montenegro and all the islands adjacent thereto. Generally speaking, the inhabitants of this coast and its hinterland were of either Latin or Slavic blood. They were, nevertheless, subjects of the Austro-Hungarian Empire and, throughout the war, fought valiantly for their emperor. In the last days of the war, when it became evident that the central powers were bound to lose, these people saw an opportunity to rid themselves of what they called the Hapsburg yoke. Hence they longed, according to their Latin or Slavic sympathy, to join with Italy or to form for themselves a southern Slav autonomy. Except in certain coast centers the Slavs were in great majority. Serbia, which had fought nobly on the side of the allies, loomed as the logical nucleus of the new Jugo-Slavia.

Much of the former Austro-Hungarian territory away from the sea was regarded as incontestably Slavic and formed no ground for dispute. The coast, however, with its old Venetian associations and its "Italian culture" and its mixed population of Latins and Slavs became, with the signing of the Armistice, Europe's livest hotbed of controversy. Italy and Serbia, who had fought side by side for years, suddenly became potential enemies. The late Austro-Hungarian subjects who had recently stood together against Italy and Serbia were now coming to blows with each other over the question of whether they were to become a part of the Kingdom of Italy or of the new Kingdom of S. H. S. (Serbia, Croatia, Slovenia).[1]

The terms of the Armistice provided for a committee of admirals from the navies of Italy, France, Great Britain and the United States, to be known as the Inter-Allied Committee of the Adriatic, to supervise the execution of the terms of the Armistice insofar as they bore upon the coast and naval material of the late Austria-Hungary.

[1] Croatia in its own language is written Hrvatska.

The *Olympia,* flying the flag of Rear Admiral Niblack and commanded by Captain Bierer, arrived in the Adriatic on January 18, 1919. The war-time mines were still in place and accurate information of safety routes was necessary in order to avoid grief. From Malta, the *Olympia* was routed to "Point B," fifteen miles northeast of Brindisi, where she was met by an Italian destroyer which gave her the instructions necessary to get to Unie Island. An Italian naval officer was waiting at Unie on the U.S.S. *Stribling.* He piloted the *Olympia* along the many-angled safety route to the mouth of the Malamocco Channel by which the port of Venice was entered. The *Olympia* moored between two buoys just off the Doge's palace. Admiral Bullard was at Venice in the *Birmingham.* Admiral Niblack relieved Admiral Bullard as Commander U. S. Naval Forces in Eastern Mediterranean and as American member of the Adriatic committee. The *Birmingham* left for home and Captain David F. Boyd relieved Captain Bierer, in command of the *Olympia.*

The Italian, American and French forces each had a certain zone of the late Austro-Hungarian coast in which they respectively took charge of enemy naval material and supervised the details of the execution of the terms of the Armistice. At the time of the signing of the Armistice the Italians had occupied that part of the ex-Austro-Hungarian territory claimed by them under the Treaty of London. Generally speaking, this was all of the territory contiguous to the sea from the old Italian border down the coast to Cape Planka in Dalmatia and included most of the Dalmatian Islands. This was generally called the Italian zone. Because they claimed this area as part of "Italia irredenta" the Italians not only supervised the execution of the terms of the Armistice in their zone, but occupied it with force and governed it martially as conquered and regained territory.

From Cape Planka southward to a point just north of Ragusa the section of the Dalmatian coast was commonly referred to as the American zone, with Spalato as the center. The American Navy did not, in any sense of the word, occupy this area, but had taken over and manned with shipkeepers two ex-Austro-Hungarian battleships, the *Zrinyi* and the *Radetzky,* and three or four little torpedo boats which were anchored in the Canale Castelli near Spalato. Our supply depot was at Spalato. No American

troops were in that part of the world and no men were maintained ashore except in connection with the supply depot and port office. This zone was occupied by Serbian soldiers and was governed by the "Provincial Government of Dalmatia," consisting of a provisional president and staff whose appointments were controlled or, at least influenced, by the Serbian Government at Belgrade. Let this point be plainly understood, for therein lay one of the chief difficulties with which the American admiral had to deal. This section was technically ex-enemy territory awaiting the decision of the peace conference as to its ultimate disposition. It was supposed to be provisionally and impartially governed but

Photo Wayne

BALKAN HOSPITALITY, SPALATO, 1919

because of the Slavic sentiment of the majority and because of the encouraging presence of the Serbian Army most of the people already considered themselves a part of the newly organized Kingdom of Serbia, Croatia and Slovenia, and, in spite of the disapproval of the other powers, the administration of the internal affairs of this zone was actually being dictated by the Belgrade Government.

The pro-Italian element of Dalmatia, and particularly of Spalato, was in the minority but it organized itself and diligently pursued its intent to bring about the annexation of Dalmatia to Italy. This was the Dalmatian situation, then, in February, 1919. The local ground was the bone over which the two civilian ele-

ments were snarling and snapping. What was more serious, Italy and Serbia were standing by for real trouble. What particularly galled the people of Italy was the idea that these people, Slavs or what not, had fought the war on the losing side, and now, having lost the war, they proposed not only to forfeit nothing, but to gain a place of advantage as part of Serbia, thus coming out on the side of the winners. The Italian point of view did not admit, however, that a similar miscarriage of war equity would apply in the case of those ex-Austro-Hungarian subjects who now proposed to become a part of Italy.

The U.S.S. *Israel,* Lieutenant Commander Barker, had been for several weeks at Spalato acting as station ship and keeping the admiral in touch with the situation. The admirals of the Adriatic Committee were in their flagships at Venice throughout January and the first half of February. Barker's reports from Spalato during February were such that the committee decided to go there with all their flagships and sit on the lid. The town was in disorder; flags were being mutually insulted. Street fights were common and no one dared go alone in the dark for fear of being stoned by political opponents.

This was the mess that Admiral Niblack found at Spalato when he arrived there in the *Olympia* on February 22, 1919. This zone of Dalmatia, ex-Austria-Hungary, occupied by Serbian soldiers, governed by Jugo-Slavs who four months before had been Hapsburg subjects, containing two brawling elements as irreconcilable as a dog and a cat sewed up in a gunny sack; this was the disturbance in which the British, French and Italian admirals expected the American admiral to raise his magic hand and say, "Peace, be still!"

The Jugo-Slavs looked upon our President as the greatest man of all ages. He was the man who had stood up for the rights of "small peoples" and he was the man who had made it possible for them to "self-determine" themselves. They had made plans for a big demonstration of welcome to Admiral Niblack. They had knowledge of the significance of February 22 and had filled the town with calls to the people to turn out on that day and do honor to three great Americans, Woodrow Wilson, George Washington and Admiral Niblack. One could easily imagine the *hoi polloi,* embarked on a noisy demonstration in favor of the Americans,

taking advantage of the immunity of the celebration to thumb a privileged nose at the onlooking Italians. Needless to say, Admiral Niblack declined to be received except in exactly the same manner as were the other admirals.

On February 24 the Italian chief of staff was rudely jostled and jeered in the streets and this indignity was followed by a general demonstration of Jugo-Slav hoodlums against the Italians. This was the beginning of the *Olympia's* troubles at Spalato. Naturally, the proper people to keep order in the town were the police, backed up by the Serbian soldiers. The Serbs had such a singleness of viewpoint; the Italians were so sensitive about their honor, and they were both so unwilling, for the time, to "speak" to each other, that it developed that the American admiral undertook to insure good order by landing an international patrol in the city. As navigator of the flagship I fell into the job of senior patrol officer. From that day on, for nine months, I was intimately associated with the life of Spalato. To my duty of patrol officer was added the function of general handy man for all shore activities. I became the admiral's messenger for ordinary dealings with the foreign senior officers and particularly for the almost daily "kicks" registered by the Italians and Jugo-Slavs, each against the other.

The town was divided into four zones and into each we put a patrol consisting of four American, four French, four British and four Italian bluejackets. An officer from each of the nations commanded one of the patrols. At first each patrol was accompanied by a Serbian soldier to keep away the curious children and act as a local guide, but the Serbian authorities soon removed their men because there was no patrol commanded by one of their officers. The guard changed every four hours and was maintained throughout the twenty-four.

For the first few days the process of changing the patrols gave some concern, always attracting a crowd of spectators. Communication with the British was all right but getting the idea to the Italians and French was another matter. Ever since that time I've been an ardent advocate of modern languages. I found myself willing to exchange what I had learned about the dygogram for a modest vocabulary of French and Italian. Try it yourself, to the retiring patrols, in those two tongues, "Fall out and fall in by

nations!" One old sailor, watching the performance, said, "You sure have got one hand from each part of the world in that working party!"

This patrol did good work, or at least it had a good effect. For several days there was no trouble in the town. Everyone felt that the eyes of four nations were on him all the time. The continuous round of four hours on a small beat was annoying to some of the foreigners. French and Italian junior officers sometimes led their patrols to a back street and let them amuse themselves at will for the greater part of the watch. Some were more enterprising. Once a French subaltern was found in the public garden putting his four nations through the French manual of arms. After a week everything was so peaceful that the admiral had sent me on a Sunday afternoon to inform the other admirals that the patrol would be recalled. I was just going up the side of the *Nino Bixio* to see the Italian chief of staff when the Italian admiral, himself, rushed out on the quarterdeck, grabbed me by the shoulders and turned me around facing the gangway, crying, "Go, go, there is a riot at Cafe Nani! Go and stop it!" So the international patrol remained on the job.

There were fifteen or twenty children who roamed about in a band, uncared-for and absolutely unconnected with any family or organization. They ate what they could find and slept wherever they happened to be when sleep came to them. The stronger of the boys found ready employment about the piers where the foreign men-of-war were moored. In exchange for a handout of left over food these chaps kept the pier clean, brushed and painted the anchor chains, and did errands. The whole party lived on the refuse from the ships. Once when there were no men-of-war at the piers the U.S.S. *Dorsey* was at a buoy in the harbor. Two or three of these rats improvised a raft and paddled themselves out alongside the ship. Getting the attention of some men on deck, they pulled long faces and stroked their stomachs while the spokesman called, "Dorsée, come back! No mangée!"

There was one little fellow, Ivo, who was badly crippled. He walked with two crutches of the most primitive sort. One day one of these was broken and a man from the *Olympia* found Ivo in the street struggling bravely in an effort to lash the broken parts together. This bluejacket happened to be a carpenter's

mate. He went aboard ship and made for Ivo the prettiest pair of crutches I have ever seen. He put soft pads on them and, with a knowing kindness, he added a coat of bright red paint. After that Ivo would not have exchanged places with any two-legged boy in Spalato! One day while the *Olympia* was away at Constantinople I found Ivo sitting on the sea wall, with his red crutches in his lap, gazing at the *Olympia's* vacant berth and weeping his poor little heart out. Asked why he was crying, it developed that some cruel joker had told him that the *Olympia* had been lost at sea with all hands!

In the early days of 1919 our force in the Adriatic consisted of the *Olympia* and six destroyers, the *Stribling, Schley, Israel, Maury, Lansdale* and *Gregory*. From time to time these ships were sent home as others came out to relieve them. Two subchasers left over from the Corfu outfit were also in our force. We had port offices at Venice, Trieste, Spalato and Ragusa. The American Relief Administration and the American Red Cross were active throughout the country around these ports. American merchantmen were arriving frequently with relief supplies and the port offices were organized to give all possible assistance to the merchant ships. All commercial ships coming into the Adriatic had to stop at Gallipoli, under the "heel" of the Italian "boot." There an American officer gave to our merchant ships a booklet of information on the mines of the Adriatic and definite routing instructions for the port where he was bound. There was also a glossary of Italian expressions likely to be broadcasted by radio, such as *mina gallegiante,* floating mine, *boa rossa,* red buoy, etc. Only the most important of the lights were going in the Dalmatian Islands until Admiral Andrews found a means of supplying the government with a quantity of kerosene. We usually kept a destroyer at Venice and one at Trieste, Fiume, Spalato and Ragusa. These ships supported the port offices, provided communication and kept the admiral in touch with the situation in the various ports. Where there was no American consular officer the destroyer captain and the port officer, between them, fulfilled as far as possible the functions of a consul. The regular passenger-carrying steamers had not yet resumed their routes and commercial transportation up and down the Adriatic was rare. One might wait a month for a merchant ship on which to go from

Trieste to Cattaro. American government officials, doctors and relief workers had need of transportation in the execution of their important business and in such cases the destroyers were in a position to meet the emergency. Epidemics were checked and starving babies were revived by such use of American destroyers carrying American doctors and American milk.

Rear Admiral Philip Andrews relieved Rear Admiral Niblack on March 26, 1919. Admiral Andrews, in addition to carrying out the policy of our government out there, set about soon after his arrival to try to improve the economic conditions in the Adriatic. With the assistance of his force medical officer he influenced the local authorities to improve the unsanitary conditions existing at Spalato. A *Dan Cistoce,* cleaning day, was arbitrarily set for June 2. The mayor published notices calling on the citizens to turn out on *Dan Cistoce* and thoroughly clean their premises. A prize was offered for the place that showed the greatest improvement. A photographer made snap shots of the dirtiest places. When June 2 came around there was a lot of scrubbing and many dismal corners were transformed by a liberal use of whitewash. The city took part by building three modern, sanitary, public latrines. The idea made a hit with the people and I am told that every year since then June 2 has been *Dan Cistoce* at Spalato. Perhaps years from now some local Tom Sawyer, plying his whitewash in the Narodni Trg, will pause in his fatigue and damn those Americans of 1919 who started this exacting custom.

Due to mutual distrust and lack of understanding, commerce between the opposite shores of the Adriatic was at a standstill. The Dalmatians had plenty of lumber and portland cement but had great need of coffee, salt and sulphur. The Italians had plenty of coffee, salt and sulphur but had need of lumber and portland cement. "Why don't you buy and sell from one another?" they were asked. The Jugo-Slav would reply, "If we buy from the Italian he makes us pay in lire and when we try to get lire for our kronen he runs up the exchange on us. Besides, we don't like the Italians anyhow." The Italian answered, "If we come to Spalato to buy or sell the Jugo-Slav arbitrarily runs up the export or import duties and makes a prohibitive tariff. He is a bad fellow to do business with." Each distrusted the other and preferred to go into bankruptcy rather than make the necessary advances to build

up a mutually profitable trade. Admiral Andrews held a conference of the leading commercial representatives at which the Italian senior officer assisted. He proposed to them that an Italian merchant should bring to Spalato a cargo of sulphur and that he should receive in exchange a cargo of equal value in lumber. Lire and kronen should be left out of the consideration entirely. An agreement was reached and a few days later a schooner came in with the sulphur and went away with the lumber. The paymaster of the Italian cruiser *Puglia* and an American officer umpired the transaction. This test was satisfactory and marked the resumption of trade between Dalmatia and the Italian coast.

Stop here for a minute and think of the remarkable situation that existed. Spalato was a highly civilized element of the Venetian Republic when Columbus made his first voyage to the new world. Italy was the nation which gave birth to the great discoverer and to the man for whom our country was named. Yet here, 400-odd years later, due to the fortunes of war and to her own recognized disinterestedness, America was playing the part of mediator to these people who, in point of national age, were centuries her senior.

Our officers and men were in Spalato for months on end and we had to do something to entertain ourselves. Both the Y.M.C.A. and the Knights of Columbus conducted clubs for the sailors. There was baseball, of course. The Jugo-Slav boys took up the game and played it frequently. One time the shipkeepers of the *Zrinyi* and *Radetzky* gave a minstrel show on the beach to which the leading people were invited, regardless of politics. The guests arrived and looked around. When an Italian or Jugo-Slav sympathizer saw one of the opposite persuasion he seemed terribly upset and some actually left as soon as they saw the others. I got letters from both sides the next day, each deeply regretting that the other had created such a distressing incident on the previous night. After that we knew enough not to mix the opposite parties. We had a dance every Wednesday night, alternating sympathies. It was amusing to hear the society of the town asking, "Please, is the dance next Wednesday night for Italians or Jugo-Slavs?"

In September, 1919, d'Annunzio's coup at Fiume startled Europe. The Italian Government had agreed to evacuate Fiume. Their soldiers were in the act of leaving when the fiery poet put

Photo Wayne

PERISTYLIUM, DIOCLETIAN'S PALACE, SPALATO

himself at the head of the retiring army and led them back to the city where he remained with them in defiance of his government until he finally got what he and most of the Italians wanted. The news of his act created wild excitement at Spalato. It was even believed by some that d'Annunzio intended to come on and attack Spalato. We, who were looking out for the peace of that place, had our hands full for several days. The Italian element became encouraged by the triumph of d'Annunzio. The Jugo-Slav element was incensed and embittered by it. Our daily receipt of "kicks" was steadily increased. Once I was sent at midnight to get an Italian out of jail. He had been taken from his supper table and summarily imprisoned because of some passport irregularity. The chief of police disclaimed any knowledge of the affair. The colonel commanding the troops knew nothing about it. The wife of the victim didn't know what jail he was in. There were five prisons in the town. At five in the morning I found him in one of the jails and by five-thirty he was released on peremptory representations from the admiral. A Serbian soldier had, by mistake gotten across the line into the Italian zone and the Italians captured him and scared him half to death. Out came a delegation from the beach. "The Italians are going to hang this poor soldier. In the name of humanity, can't you save his life?" That meant a hurry-up trip to the Italian senior officer. "Yes," he said, "the Serbian soldier will arrive here tomorrow to be returned to his regiment. He is fortunate to be released. He was caught spying on our troops." Day in and day out, week in and week out, we had such incidents to handle. One time I sat as senior member of a board of investigation, with British, French and Italian officers as additional members, to inquire into the truth of a statement made by an Italian sailor to the effect that while he had been a member of the international patrol the French members of his patrol threw kisses to Jugo-Slav ladies and conducted themselves in a manner outwardly favorable to the Jugo-Slavs.

But the most important event that took place in the American zone was the Trau affair. Trau is a small seaport fifteen miles west of Spalato and very close to the Italian lines, that is, the line beyond which lay the zone occupied by the Italian army. There was an Italian colony at Trau led by a man of poor judgment who imagined himself a second d'Annunzio. He got the sympathetic

PERISTYLIUM, DIOCLETIAN'S PALACE, SPALATO

Photo Wayne

ear of some junior officers of the Italian army just across the border and arranged with them to come down to Trau and seize the place for Italy. They came down early one morning, seized and locked up the Serbian guard, and announced with placards that Trau was thereafter under Italian rule. The American senior officer at Spalato was asked to use his good offices to straighten things out. Some bluejackets were landed at Trau to keep order for a few hours. The matter reached the American press in a garbled fashion and congressmen were rising in their wrath to know why American marines had been landed at Fiume, etc. The clearest statement of just what happened is quoted herewith from the 1919 report of the Secretary of the Navy:

In September a small guard of American sailors were landed at Trau, at the request of Italian authorities. The following dispatch from Admiral Knapp, sent from United States naval headquarters, London, September 30, gives the facts with reference to the landing, and is a concrete example of the wisdom and sound judgment displayed by our naval officers abroad:

"The Armistice line extends from Cape Planka inland. North and west of this line Italian troops in occupation, south and east of the line garrisoned by Serbian troops. This latter section, Dalmatian coast, headquarters American naval forces, in which by agreement after Armistice naval forces took charge of all one-time Austrian-Hungarian vessels found there, and which has since been generally called American zone. Americans have no troops on shore, but have extended a strong moral influence for the preservation of order and avoidance of clash between Italians and Jugo-Slavs. There has been considerable friction along Armistice line between Serbians and Italians, but by the tactful firmness of American admiral there, it has been kept from causing serious results.

On September 23 three truck loads of Italian soldiers, in command of an Italian army captain, crossed Armistice line from Italian zone and surprised and captured the small Serbian garrison at Trau. The Italian authorities informed the senior American officer present, Captain Boyd, that the move was unwarranted, and asked that the raiders be turned back. Boyd sent a destroyer and two chasers to Trau at once, then saw the Serbian commander and got him to agree not to order an advance until he had an opportunity to get Italians to withdraw. He sent Lieutenant Commander R. S. Field and Commander Maroni, of the Italian ship *Puglia*, by automobile to Trau, and himself went in the U. S. S. *Olympia* to Trau. On arrival he found that Italians had been induced to return, leaving, however, Italian army captain and three soldiers, owing to breakdown of truck. He landed a small guard from U. S. S. *Cowell* and U. S. S. *Olympia* to see no harm was done by Italians and preserve order pending arrival of Serbian troops. He put the Italian army captain and three soldiers on an Italian motor boat and turned them over in charge of an

Italian naval officer. Upon arrival of Serbian troops he withdrew bluejackets, after first receiving assurance that no violence would be offered to civilians.

Italian Admiral Millo, in command of ships and troops in Italian zone of occupation, sent senior Italian officer present at Spalato to U. S. S. *Olympia* with thanks for sending Trau raiders back. He brought the officer commander of the raiding force to trial by court-martial. The whole affair was most creditably handled and the prompt action of Captain Boyd, in my opinion, undoubtedly prevented a very serious incident which might have resulted in open warfare between Italians and Serbians. The landing was for the protection of the offending Italians left in Trau until adequate Serbian forces could arrive to preserve order.

The fact that Italian authority requested action of Captain Boyd, and that he was thanked by Admiral Millo for his action, and that Admiral Millo brought offending officer to trial by court-martial, all go to show that the raid was an isolated act of hot-heads, done in defiance of Italian authority, and that America acted in cooperation with Italians to restore the situation. That no serious result happened is due to the prompt and efficient action of American forces. Had they not so acted, there would almost inevitably have been bloodshed, which would perhaps have resulted in a state of actual war between Italy and Jugo-Slavia, owing to the intensity of feeling existing over the Dalmatian question."

It is all over now and everything is serene between Italy and Jugo-Slavia. Lest some reader deplore the recounting of bitter incidents which grew out of a dispute between two great nations, attention is invited to the fact that a review of the trying incidents and crises of that period reflects all the more credit upon modern diplomacy and upon the wise Italians and Jugo-Slavs who used diplomacy instead of arms to settle their dispute.

NAVAL RADIO PROGRESS

By Lieutenant Harry F. Breckel, U.S.N.R.F.

THOSE of the "old timers" who served with the fleet from 1915 until the end of the late war with Germany and became "past-masters" in the art of controlling the functions of the radio installations then in vogue would doubtless be somewhat bewildered, if not temporarily helpless, if they were suddenly called upon to "take the watch" in the radio station on board one of the more modern ships of the line such as the *Colorado*. That is, they would unless they had kept up with the tremendous strides of progress the art of radio has undergone since the war through reading or by reason of being connected with the art in a commercial capacity.

Since the war we have had many advancements in the art, among them being the perfection of high-power transmitting vacuum tubes and circuits; long range radio telephone transmitters such as are used in the now internationally popular art of "radio broadcasting"; efficient long range aircraft radio apparatus; radio beacons for navigating aircraft and many others too numerous to mention. Quite in keeping with its usual policy and realizing the importance of the radio communications branch of the service, the Navy Department has not only kept abreast of developments in the art of radio in general, but has vastly improved its radio systems, through the diligence and inventive genius of its own corps of expert engineers, laboring incessantly in the laboratories to help maintain the high standard of efficiency that the naval radio service has always set, thanks to superior equipment and personnel.

Without doubt the outstanding development in radio apparatus for naval stations during the past year has been the so-called "coupling tube system," the invention of Dr. A. H. Taylor and L. C. Young, both former naval officers during the late war and now in charge of experimental and development work at the

Naval Experimental and Research Laboratory, Bellevue, Anacostia, D. C. This device has made quite practical and possible that which the majority of radio engineers were prone to claim as impossible of accomplishment: namely, "multiple reception on a single antenna without interference." Unfortunately, technical details as to the exact design of the unit have not been made available by the Department for publication, but it might be stated that the device is the embodiment of simplicity insofar as appearance is concerned, and, in general, is presumed to have been modeled somewhat along the lines of the little known but highly efficient so-called "Wave Rejector," a development of the British forces during the war regarding which comparatively little was known in spite of the fact that it is supposed to have been in use for some seven years.

The standard unit as used by the Navy is quite similar in appearance to the familiar wave trap used by broadcast fans to improve the selectivity of their receivers and assist in the elimination of unwanted, interfering signals. The device would undoubtedly have wide application for use in connection with broadcast receivers and it is understood that the Navy Department, realizing this feature, has adopted a favorable attitude in respect to the disclosure of the technical details and circuit, provided a satisfactory arrangement can be made with the commercial manufacturers relative to placing the unit on the market.

The U.S.S. *Colorado,* the latest and most powerful addition to our fleet, recently made use of this system on a cruise off the Atlantic Coast, the tests conducted being highly successful, the operators on board the dreadnaught receiving simultaneously signals from the naval shore radio stations at Philadelphia, Guantanamo, Cuba, Charleston and several ships operating on the distress signal wave length, while at the same time duplex high-power transmission with the shore stations located at San Francisco and San Diego, California, was carried on. The new model "TL" tube transmitter was used also during these tests for transmitting and the signals from the *Colorado* were heard as far west as the Hawaiian Islands, as well at other points on the west coast.

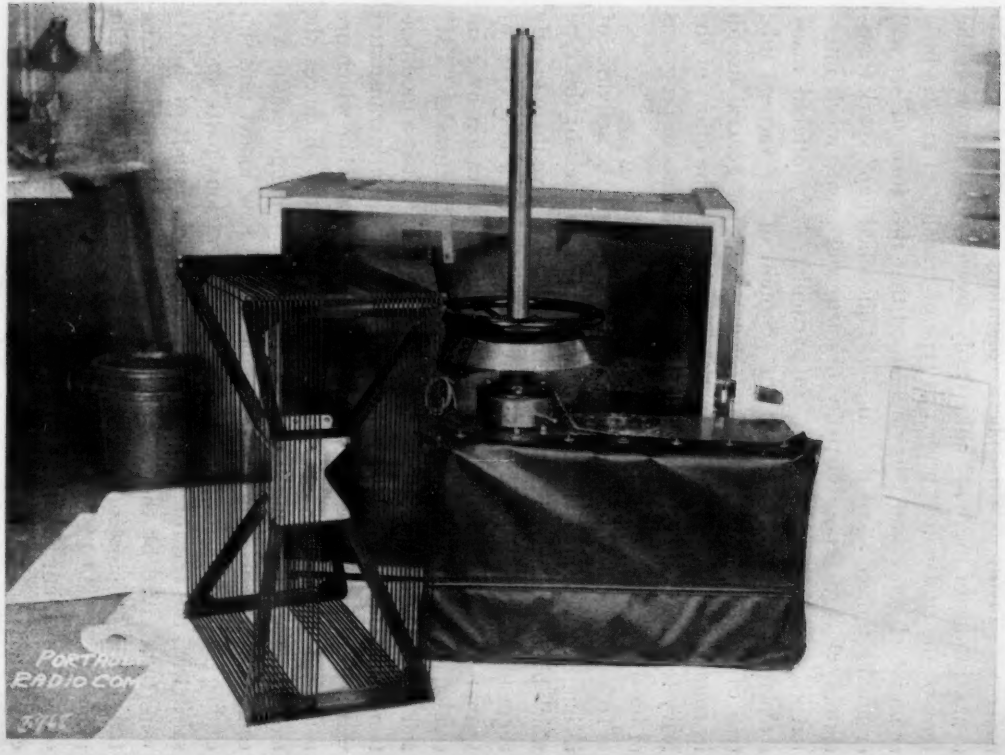
The model "TL" transmitter, probably the last word to date in tube transmitting units, is known as the "primary" battleship

THE SONIC DEPTH FINDER APPARATUS

transmitter and employs two six-kilowatt water-cooled vacuum tubes which are commonly termed "power tubes." This highly efficient unit provides reliable communication day or night under adverse conditions, over a range approximating 1,000 miles, while under more favorable atmospheric conditions ranges of from 2,500 to 3,000 miles or more are quite easily covered. By reason of the form of the transmitted wave this type of transmitter creates little or no interference and it is understood that this form of set will eventually replace all of the old style "quenched gap" spark transmitters which are now virtually obsolete and create much interference. The broadcast fans, in particular, have offered many complaints in this respect and the adoption of the vacuum tube type of transmitter by the Navy Department for general use in its communications service is another example of the effort of the Navy to reduce interference by its numerous stations to programs of broadcasting stations.

To keep pace with the ever-increasing radius of the activities of its huge fleet, submarines, as well as other war vessels of this type which have been so developd since the war as to give them greatly augmented cruising ability, the Navy has adopted a new type of vacuum tube transmitter to provide for communication over increased ranges. This transmitter is known as the model "TM" and comprises a tube system of 100 watts power. It is a modification of the old style, one-half kilowatt, quenched spark transmitter with which the submarines were formerly equipped, but which are not capable of sustained communication over the distances the modern submarine is now able to cruise. The same general power equipment was used in the designing of the new model unit, including the panels for the mounting of the various parts and, in spirit with the cry for government economy, thousands of dollars were thus saved by the adoption of this policy for modernizing transmitting equipment for the undersea boats of the Navy. The range of the model "TM" transmitter far exceeds the range of the original one-half kilowatt spark sets, causes less interference, emits a pure, sharp wave and, in general, is much superior in operating efficiency.

In line with the policy of increasing the efficiency of its ship stations the Navy has also made some radical departures in the



PORTABLE RADIO COMPASS OR DIRECTION FINDER

shape of modernizing its high-powered shore radio system. The principal developments in this respect are three: namely,

(a) The establishment of "monitor receiving stations" to operate in conjunction with certain high-powered transmitting stations located in or near large centers of population, for the purpose of reducing or eliminating interference with reception, due to industrial power lines or other sources of disturbing potentials.

(b) The conversion of the old style "spark" transmitters into vacuum tube units of the so-called "alternating current" type to greatly increase their range and selectiveness and, further, to minimize their interference with other receiving stations located near by.

(c) The adoption for use of a circuit termed the current transformer circuit, to be utilized in connection with the Navy's medium and high-powered arc type transmitters of from thirty to 500 kilowatts, to eliminate the troublesome "compensating wave" as well as objectionable "harmonics" and "mush."

The art of sonic depth finding being so closely allied to that of radio it might prove interesting to touch on that subject also, a sound section being a component part of the Radio Division of the Bureau of Engineering. The sonic depth finder is the outcome of research work carried on by Dr. H. C. Hayes, Ph.D., of the experiment station of the Bureau of Engineering, Navy Department, and brought to completion in June, 1922. Comprehensive tests of the device have been made and the reader is doubtless familiar with the results obtained through the use of the apparatus by the U.S.S. *Stewart,* by means of which the ocean bottom was sounded during a cruise from Newport, Rhode Island, via the Mediterranean Sea, to China. On the return of this vessel from the China Station she will have completed a line of deep soundings encircling the globe. A more recent survey has been conducted at the request of the Carnegie Institution of Washington which asked the Hydrographic Office to have soundings taken off the coast of California. This resulted in the Navy Department fitting out the destroyers *Hull* and *Cory* with the sonic depth finder equipment, through the medium of which an area of sea bottom totalling approximately 38,000 square miles was surveyed, the vessels steaming at twelve knots speed and completing the survey in thirty-eight working days, the actual distance covered

being 5,800 miles, while the average distance between soundings was from one to two miles. The same destroyers have more lately been engaged in sounding out a cable route for the U. S. Army in Alaskan waters, during which work the *Hull* was fortunately close enough by to render valuable assistance to Major Martin, the initial commander of the Army Air Service round the world flight.

Briefly stated, the principle of design of the sonic depth finder is based upon the theory that a sound impulse emanating from a given point near the surface of the water will be reflected back to that point by any submerged surface within its range of propagation. Thirty-five hundred (3,500) fathoms have already been obtained through the use of the sonic depth finder, but in shallow depths of water the "time elapse" method is not applicable and the so-called "angle method" is employed. The angle method enables soundings to be taken in depths of from three to sixty fathoms below the keel and recent reports from submarines indicate that depths as shallow as one fathom below the keel have been successfully and accurately measured.

Another recent example of the increasing effectiveness and importance of sound receiving and transmitting devices on board ships of the Navy was observed when the *Raleigh*, using her directional sound receivers, heard and obtained an accurate bearing on the Nantucket Shoals Light Ship 1,000-cycle oscillator which, at the time, was some sixty miles distant.

And so, realizing the ever-increasing and vital importance of a superior radio communication service, the Navy keeps pace with the unceasing development of this science, doubtless intending to maintain the high standard of efficiency that it has always set, both from the standpoint of equipment and of personnel and, further, with the obvious determination to possess in the future, as it always has in the past, the world's most effective and reliable radio system of communications.

THE ABUSE OF THE COURT OF INQUIRY[1]

By Lieutenant Commander T. L. Gatch, U. S. Navy

"It is well if the court shall acquit thee;
It were best hadst thou never been tried."

THE purpose of the Court of Inquiry is set out in section 1042, *Naval Courts and Boards, 1923:* "Purpose.—In important cases, where the facts are various and complicated, where there appears to be ground for suspecting criminality, or where crime has been committed, or serious blame incurred without any certainty on whom it ought chiefly to fall, a court of inquiry affords the best means of collecting, sifting, and methodizing information for the purpose of enabling the convening authority to decide upon the necessity and expediency of further judicial proceedings." Section 1041 states that the convening authority "should remember that any action taken in a matter subsequent to its investigation by a Court of Inquiry is taken upon the initiative of the convening authority in his administrative capacity. The function of the Court of Inquiry is merely to aid such officer in the performance of his administrative duties, and is not to relieve him of responsibility for his administrative acts." This provision of section 1041 is not to be found in *Naval Courts and Boards, 1917.* It must have been added for a purpose. The purpose would seem to be to emphasize the fact that whether a convening authority orders a court-martial, or takes other disciplinary action, as a result of a Court of Inquiry, or simply upon the facts as known to him and without recourse to any board, is immaterial. So far as concerns the convening authority whatever action he takes is his own and the responsibility is his. This responsibility cannot be shifted in the slightest degree to a Court of Inquiry.

In a large number of cases where a Court of Inquiry is now convened it is submitted that the Court of Inquiry does not actu-

[1] I have referred to the Court of Inquiry only in this article; the Board of Investigation is analogous.

ally aid the convening authority in arriving at a determination as to his course of action as to any particular individual. This for the reason that there are certain fundamental differences between the Court of Inquiry and a trial which it is believed are frequently lost sight of and are apt to mislead, and furthermore, because the case does not come squarely within the purpose of the Court of Inquiry. The differences between a Court of Inquiry and a trial will be taken up later. First let us examine the provisions governing the convening of a Court of Inquiry to see if it is mandatory to convene one in any case, and if so, in what.

Section 1043 of *Courts and Boards* reads: "When to be convened.—Officers so empowered are expected, on the occurrence of any matter serious enough in their judgment to require thorough investigation, to order a Court of Inquiry as soon as practicable. Among such occurrences are included the following:" This section in itself would appear to require a Court of Inquiry in practically any serious case. But the two following sections are virtually a continuation of this section, covering the most probable and most serious cases. It should be noted that section 1044, dealing with accidents involving loss of life, provides that the circumstances be as set forth in section 1042, that is to say, in what is conceived to be the most usual case, where serious blame has been incurred without *any* certainty on whom it ought chiefly to fall. If there is certainty on whom the blame ought to fall, it is submitted that a court-martial may be ordered at once, and a Court of Inquiry is not mandatory. Section 1045, dealing with cases involving serious damages, requires a Court of Inquiry in cases of collision, grounding or other important casualties (not involving loss of life, which would come under the preceding section) which convening authorities "deem necessary to be investigated." This leaves a wide discretion with the convening authority. He clearly is not required under this provision to deem a case necessary to be investigated where he is convinced that a court-martial will bring out all the facts and that a Court of Inquiry will accomplish no result at all commensurate with the time and energy it will necessarily expend.

The fairest and quickest investigation of facts in the Navy is the captain's mast. The convening authority of a Court of Inquiry cannot hold mast. But he can have an officer of his staff

hold it for him, digest the results and lay them before him. This could probably be best accomplished under our procedure by ordering the officer to investigate under the authority of section 183 of the Revised Statutes, as set out in chapter fifteen of *Courts and Boards.* This officer should find facts; he should express no opinion in writing. Such proposed course of action would enable one officer to do what three are now required to do, and would, in most cases, result in its being done better. The ordinary board is "long, narrow and wooden." It is an unwieldy instrument. A one-man investigation may be as narrow and wooden, but in length more resembling a club—often a very useful instrument. At any rate, the responsibility is the convening authority's. A member of his staff, being in close personal contact with the convening authority, can very easily learn just what the latter wants and can get the facts for him.

Reverting to the statement that a Court of Inquiry is apt to mislead, it should be noted that by Article 67 of the "Articles for the Government of the Navy" a Court of Inquiry shall express its findings of facts only, and that the expression of an opinion is the exception. A recommendation by a Court of Inquiry is not mentioned in the law. It has been foisted upon the procedure. If the Court of Inquiry were confined to the expression of facts it would not tend to mislead. But the opinion and recommendation have become the rule, not the exception. Even if the Court of Inquiry were confined by its precept to the finding of facts, why waste the time of three men where one man could do the job even better? The precept of a Court of Inquiry given in section 1076 of *Courts and Boards* orders the court to include in its findings a full statement of the facts it may deem to be established. This requirement is essential if the Court of Inquiry is not to be abortive. Emphasis should be laid on the word "deem." Then, and necessarily based upon these facts "deemed" to be established, the court is ordered to express an opinion and to make recommendations. Now "deeming" a fact to be established is a far cry from having that fact proved "beyond a reasonable doubt." The first is what is called in technical language "the preponderance of the evidence" and is explained in section 605 of *Courts and Boards;* the second is familiar to all officers. From this difference in function comes the discrepancy so often remarked be-

tween the opinion given by the Court of Inquiry and its recommendations, and the results reached by the subsequent court-martial. The Court of Inquiry tends to recommend too many courts-martial. We should err by having too few.

As an illustration let us imagine a serious accident in which a number of individuals are involved. There is no question but that serious blame has been incurred. The is no question, from the inherent nature of military organization, but that this ought chiefly to fall upon the responsible senior officer. The only question is upon what subordinate officers ought it to fall also? The one-man investigation starts. As this one man is interested in facts only, he works fast. He is not trammeled by the necessity of forming an opinion. Upon the conclusion of his work he lays the record before the convening authority. The latter, at his convenience, having the investigating officer practically always at hand, questions him: "Upon what evidence do you find this as a fact?" The investigating officer explains. The convening authority decides whether that evidence would be sufficient to establish the fact beyond a reasonable doubt. Finally he determines upon his course of action: "There is no question but that A, who was in command, is largely to blame. It was his duty to keep himself informed. You have found that he failed in this. Even if your finding is too much snap judgment still the conclusion is inevitable that if he were informed he failed to act properly upon his information. In either case he must be court-martialed. With regard to B, you find that he failed in his duty of keeping A thoroughly informed as to the conditions. B is in the same boat with A. As to C and D, I doubt from what I now know that a court-martial would convict them. If it would not they should not be tried. At any rate enough will be brought out in the trials of A and B so that I can then decide about C and D. Draw up the charges and specifications for A and B, and in doing so remember that at the start, at least, we were all endowed with our share of the milk of human kindness."

DISCUSSION

Blood Is Thicker than Water

(See page 91, January, 1925, PROCEEDINGS)

H. C. PALMER.—It is not often that articles appearing in the PROCEEDINGS may be criticized as to accuracy but some of the statements made by Willard C. Tyler, in his contribution "Blood is Thicker than Water" in the January number, are at such variance with the usually accepted version that the two cannot be reconciled. If the article is simply meant to give the recollections of Admiral Keppel, that is one thing. If it is supposed to be history, as the author seems to assume, that is quite another. In "Reminiscences of the Old Navy" is a detailed account of the Pei-ho episode that the author, E. S. Maclay, says is taken from the journal of Rear Admiral S. D. Trenchard, who served with Tattnall at that time. No account that I can find differs materially from Trenchard's except Tyler's, and here the difference is great. As Trenchard wrote on the spot, and Tyler gives a recollection of a conversation he had twenty-five years ago with a man who was relating his recollections of what had happened forty years before that, Trenchard's journal is more likely to be correct.

In regard to the northwest boundary, it is recorded that the "Fifty-four forty or fight" matter was settled in 1844, long before the Pei-ho incident. As the emperor of Germany was engaged in war in 1870 and 1871, he was hardly a person to be chosen as the arbitrator on a boundary dispute or to have the time to give to such a matter.

EDITOR'S NOTE: The above was referred to Mr. Tyler, who comments as follows:

I have before me yours of the twenty-first, enclosing Mr. Palmer's comments on my article entitled, "Blood is Thicker than Water," as published in the January issue of the PROCEEDINGS.

In reply, I can only say that I had no intention of either attempting to make or mar history, but only to relate the story of the origin of the famous saying exactly as related to me by Admiral Keppel who was there, bearing the rank of commodore at that time.

Mr. Maclay, in his very able naval history, gives the account of the same incident as set forth by Admiral Trenchard, who was also there, probably bearing the rank of lieutenant at that time. Their respective rank does not matter, but the stories differ widely.

I have heard the Keppel version of the origin from a number of people, including another British naval officer, mostly in England, so it

is evidently current in some places. There were no less than four distinct rows and fights between the British and Chinese in the Pei-ho region in 1857, 1858, 1859 and 1860. Only in the last one did the French come in, on account of the murder of one of their missionaries.

In re the Northwest Boundary dispute, I never stated whether it occurred before or after the Chinese incident; but I do find that I unconciously made a partial error of statement which Mr. Palmer did not discover, although making one himself. He states that the "Fifty-four forty dispute was settled in 1844." This is not correct. It was the slogan that year of the party which elected President Polk. He was pledged to "Fifty-four forty or fight," but dared not live up to it because it meant war with the British. At that period the somewhat hazy northern boundary of Oregon (Washington Territory was not then set off from Oregon) was supposed to be at that degree of latitude. A convention existed between Russia and the United States that the former, which was believed to control the region north of that line, should make no settlement south of it and that we should allow none north of it. A precisely similar agreement existed between Russia and Great Britain.

In 1845 or 1846, being threatened with war if we persisted, Mr. Polk appointed James Buchanan as our commissioner, in conjunction with Richard Pakenham for the British, to settle the matter. They finally agreed that the northern land boundary should be fixed at Latitude 49 and it was ratified by our Senate on July 17, 1846 (not 1844). Thus we were deprived of some 450,000 miles of additional wilderness. At this conference the water boundary was fixed as described in my article, only it did not stay fixed for many years afterward and was finally left to arbitration.

Shortly after 1846, another dispute broke out between Great Britain and the United States as to whether, in the agreement of 1846, the water boundary was actually established in the Haro Channel, or the Rosario Strait. If the former, it gave us the San Juan group of islands (Haro Archipelago). If the latter, they went to Great Britain. This contention continued until about 1859 when another step was taken in an agreement for the joint occupation of San Juan Island, the largest of the group, by the troops of both countries until the matter could be settled.

Impossible as it may seem, the dispute still dragged along until 1871 when both sides agreed to leave it to the German Emperor, *and this was done*. As the Emperor William's war with France began on July 29, 1870, and Paris surrendered on January 28, 1871 (six months), it is difficult to believe that he was then too much occupied to take on this arbitration as Mr. Palmer seems to think, *because he did accept it* and gave his decision on October 21, 1872, in our favor, awarding us the San Juan islands.

EDITOR'S NOTE: Although the Institute is not responsible for the contents of articles appearing in the PROCEEDINGS, the following note is added in the interest of historical accuracy. Both the accounts of Rear

Admiral Trenchard, U. S. N., who was executive officer in the *Powhattan* at the time (see Maclay's *Reminiscences of the Old Navy*), and Clowes' *History of the Royal Navy* (Vol. VII, p. 130 ff.) are in agreement as to the main facts of the British attack on the Chinese forts at the mouth of the Pei-ho River. This took place on June 25, 1859. Although both French and British forces were present, only the British gunboats, under the command of Rear Admiral Sir James Hope, crossed the bar at the river mouth and took part in the action. At this time Commodore Tattnall, U. S. N., was off the mouth of the river in U. S. S. *Powhattan,* with the American envoy to China, Mr. Ward, on board, and went inside the bar in the small chartered Chinese steamboat *Toey-whan,* in an effort to take the envoy to Peking. In the heat of the action, Tattnall, in response to a message from the British commander (probably referring to transportation of wounded), visited the *Plover,* the British flagship, and his boat's crew, without authorization, operated one of the *Plover's* guns for upwards of an hour.

In regard to subsequent assistance given by the *Toey-whan,* Clowes states: "A landing force, chiefly made up of about 350 marines and bluejackets, was brought from the vessels below the bar. There is strong evidence that Tattnall's steamboat, the *Toey-whan,* was allowed to assist in towing part of it up the river, though, no doubt, the nominal mission of the little craft was to fetch wounded from the gunboats below the barrier."

Regarding Tattnall's famous remark, Trenchard says it was made to him personally just before the visit to the *Plover.* Clowes gives the following account: "'After the retirement,' writes a distinguished officer who was present, 'the *Coromandel* received as many wounded as she could stow, and the rest were sent down by boats towed by the U. S. steamer *Toey-whan,* obligingly placed at our disposal by Flag Officer Tattnall, in, as he put it, "the cause of humanity." This is when the expression "Blood is thicker than water," was used by him to my chief, Sir James Hope. It was on the day after the action.'

"As the officer from whom I quote this was the rear admiral's secretary, there can be no doubt that Tattnall used the expression on the occasion referred to; but there is some evidence that he also used it on the day of the action, and also that his men used it when on board the *Plover.* I think, therefore, that, in all probability, it was an habitual expression with Tattnall at that time, and that it was imitated by his people."

Tattnall's remark could not have been made to Admiral (then Commodore) Sir Henry Keppel, for Keppel was in England in 1859, although previously, on June 1, 1857, he had commanded a division of gunboats in an attack at Fatshan Creek, near Canton. Furthermore, Keppel makes no mention of the incident in his book *A Sailor's Life.* Although there is thus some confusion in Keppel's story as given by Mr. Tyler, it nevertheless has considerable interest as an account by a prominent officer

contemporary with the episode. The Keppel story appears to refer to the Pei-ho attack, and is considerably more detailed than those by either Clowes or Trenchard, but it errs in stating that the Pei-ho forts were captured.

As for Tattnall's attitude during the whole affair, it should be remembered that, although the United States was nominally neutral, American naval forces had previously been in conflict with the Chinese, and that the activities of foreign naval forces at the time were more or less in the nature of joint operations to open China to commercial intercourse.

Regarding the northwest boundary dispute, the facts are substantially as stated by Mr. Tyler in the letter above.

"Our System of Fleet Training"

(See page 572, April, 1925, PROCEEDINGS)

COMMANDER E. G. ALLEN, U.S.N.—It is appropriate that Commander Russell Willson, who has pioneered in the Navy, among other things for signals and communications, signal books, fleet tactics, and the formation of the office of fleet training, should in his article of this number on "Our System of Fleet Training," point the way to a solution of the problem of a balanced and thorough training schedule for the fleet.

To portray the facts, disclose the weaknesses, bring out and discuss the skeleton of the family closet without offense is always a difficult task, especially if one feels keenly or is interested in a subject. The writer is to be congratulated on his presentation of the subject matter, on the logical manner of its arrangement, and on the soundness of his conclusions. His story of the growth of a gunnery consciousness, an engineering consciousness, the dawning of a tactical and strategical consciousness in the Navy is well and impartially told. It would seem that the Navy bids fair to arrive at the point where we should have started; at the point of development of a schedule of fleet training which would train officers capable of fighting a modern fleet. In other words, we are arriving at a conception of fleet readiness for *preparing to fight* and for *fighting:* namely, readiness in strategy and in tactics—basic and rightly elemental ideas from which all training schedules, all idea of operating a navy, must start.

There are so many bugaboos perpetuated in any service which is built around custom and tradition that one must always poke about gently so as not to break the gilt that covers the decay of the idols of yesterday, but having been given the privilege, I am going to take advantage of the opportunity at the expense of the Institute and the author of the article of fleet training.

The first of these is that the Fleet Training schedule is primarily for training of the men. Having spent many years on the tread mill of a strenuous yearly schedule, the idea of which is to train groups of enlisted men whose average first enlistment has been running about eighteen months, I have by slow degrees arrived at the conclusion that, since the only part

of the Navy that might be called permanent is the group composed of officers, chief petty officers, and first class petty officers, any training schedule whose object is merely to give the eighteen months' men a basic training, and leaves the permanent personnel always teaching and learning the routine of the kindergarten is bound to produce a kindergarten navy. It seems to me that whenever I have heard a proposed fleet operation discussed I have always had to listen to a chorus of unbelievers bemoaning the fact that we need drill in the fundamentals. Since the chorus is usually composed of men with whom I have spent twenty-one years picking at the fundamentals of the naval game, my blood always runs cold wondering at what age I am to stop falling on the ball and running through signal practice, and perhaps get to play a practice game or two with a scrub team. Whence are to come the fleet handlers from the groups who have spent a lifetime learning and teaching the school of the squad? I leave you, gentle reader, the idea to ponder on.

The second idea, paralleling the first, that I have never been able to reconcile with the eighteen-month average enlistment, is what particular good results to the Navy from the successful conclusion of a strenuous year of elementary routine target practices to secure prizes and letters for individuals, or in an engineering competition conducted largely to show fuel economy if the training stops yearly and starts over when this remarkable result has been attained.

If this process were continued for ten or twelve years would there not result a hardening of the brain cells of the professional personnel around the thought of performing a routine whose only justification is its successful yearly conclusion? What can the Navy have learned about fighting the fleet at the end of any performance year if this were its sole routine? Is this to be the climax of the naval training endeavor?

If at the end of any training cycle we have not increased the strategical and tactical readiness of its permanent personnel, what merit is attached to the material or gunnery readiness as of any one date? Strategical and tactical readiness properly are inclusive of material and gunnery readiness. If the gunnery schedule has not risen from elementals to their tactical application, if the material readiness is a port inspection readiness and not a readiness proved by a demonstration of its ability to be maintained during an extended fleet operation, I see nothing proved yearly—only suppositions masquerading as facts, illusions nourished and held as truths. Whenever I think this over, there comes to my mind always the picture of the American fleet huddled into the river of Yorktown in the early months of 1917.

Perhaps these comprise some of the reasons why Commander Russell Willson advocates a two-year training period. Perhaps he hopes we might sometime spend but one year in the kindergarten, and then a second on some advanced grammar school subjects, before we start over on the kindergarten class again. What evil would result from a second year whose gunnery was devoted entirely to force and fleet gunnery-tactical exercises, and on strategical and tactical games carried to the point that one felt in

them that surety and skill that comes from the experience of experts? Why not prove sometime practically over twelve months the elementary skill we are always presumed to have attained after a twelve months' training? Why not sign on the captains and heads of departments sometime to stay a two-year training period, and then shift the personnel to start over with green men in the school of the squad? There is no need to worry about the enlisted men as with the turnover and enlistment contract we work under they will always be with us as green hands.

I once read a criticism of our Navy by a British naval officer of rank, the substance of which was that we were efficient on the bright work and routine but deficient in the art of command and operation. While the point seemed to me to be well taken at the time, I became convinced later that he was mistaken and that the art of shining bright work had long been lost in the Navy, and that the time of the professional personnel was devoted exclusively to the task of insuring that they cleaned up the year's routine elementary gunnery practice and engineering exercises so that the requisite volume of statistics could be issued promptly to the reading public yearly by one March or April, or whatever the mystic date is.

Not wishing to leave in a state of depression such hardy readers as browse about in the rear pages of the Institute, I might say that since the late war, with the expansion of the Navy, and from what we learned from our allies, we are developing in our service what has been termed a Fleet Consciousness. Such things as the task organization of the fleet for training, better fleet administration and staff work, the tactical application in many forms of the target practices, the force practice of the battle fleet, the yearly fleet maneuvers, the applied war college work, the new office of fleet training, are indications of a healthy mental growth.

Commander Willson in his article on "Our System of Fleet Training" gives voice to an opinion held by the bulk of operating personnel, that "The Navy is trying to do too much in one year of twelve months and is therefore slurring the fundamentals and curtailing or neglecting proper advanced fleet work." How long should it take the administrative machine to digest and assimilate the idea, and make the necessary changes? If the proposed system were tried for two years and the experiment did not succeed, the Navy could always face without loss and with equanimity the resumption of the one-year schedule, and profit, I think, by the breathing spell.

It is essential, if we are to breed commanders who will know how to operate a fleet and a fleet that can operate under them, that for a period of three to six months every one or two years there be operated under one command in conjunction, cruising and working at sea, as many or more ships of all types than would be operated under one command in time of war; because only by practicing with the full team can the material, the methods, and skill be produced that stand up in an emergency. A fleet is a fleet only in name, if in all weathers, in maneuvers, on the range, under all conditions day and night, it has not rehearsed, mastered and met all the eventualities and learned by experience all of its limitations. Most of the lost naval

battles of the late war revolved around, first, the prior assumptions of the valor, the carelessness, or the fears of Ignorance, and later the paralysis of Ignorance when actually confronted by unforeseen facts or imagined dangers. In conclusion, let us pray for less ignorance, for wiser and better fleet operation and a lengthened fleet training schedule, that strategical and tactical Peter be no longer robbed to pay his servant gunnery and engineering Paul.

The Independent Air Force

(See page 381, March, 1925, PROCEEDINGS)

LIEUTENANT COMMANDER E. E. WILSON, U.S.N.—My purpose in discussing this paper is not to criticize but to help focus attention upon it. This subject deserves the earnest consideration of very officer with the interests of the service and the country at heart. In a brief, concise and logical paper, the author has put his finger upon a vital point. This Independent Air Force is of paramount importance to the Navy because it may, if, in fact, it has not already done so, deliver the Navy a staggering blow. It is even more important to the country because it contains the germ of a mistake in organization fraught with the utmost danger to the nation.

Briefly, the general public in the United States today feels that both the Army and Navy are too conservative and too reactionary in their attitude toward aviation to permit its proper development. This public opinion has resulted from the false position which the Navy was forced to take when combating the claims of the Assistant Chief of the Army Air Service. No matter what the circumstances are, the fact remains that the general public feels that aviation will not be given the chance it deserves as long as it is controlled by the Army and the Navy. The best answer to this is, of course, the developments which have taken place in naval aviation since the organization of the Bureau of Aeronautics.

Even those who have been most active in this development are not satisfied with this progress. The truth of the matter is that aeronautics is one of the most complex engineering problems that the country has ever confronted. The wonder is that development has been as rapid as it has. The Bureau of Aeronautics has endeavored to bring aviation to the fleet. It has developed five new types of aircraft and has put them in production. None of these types is entirely satisfactory and the history of all development indicates that no type ever will be. The Bureau of Aeronautics has developed catapults, placed them on board ship, and operated them. It has built and operated rigid airships. It has fostered the building and operation with the fleet of tenders for heavier-than-air craft. It has fostered the building of an experimental carrier and, on the basis of the experimental work, is now assisting in the design of the *Lexington* and *Saratoga*. It has brought out new types of aircraft engines without superior anywhere. This is a record of achievement of four years, and four years is a short time for any development. These developments are naval developments

and represent a technical progress more rapid and more complete than that of any other country. The public does not know this, however, and persists in the opinion that aeronautic development has been retarded rather than advanced, by the Army and Navy.

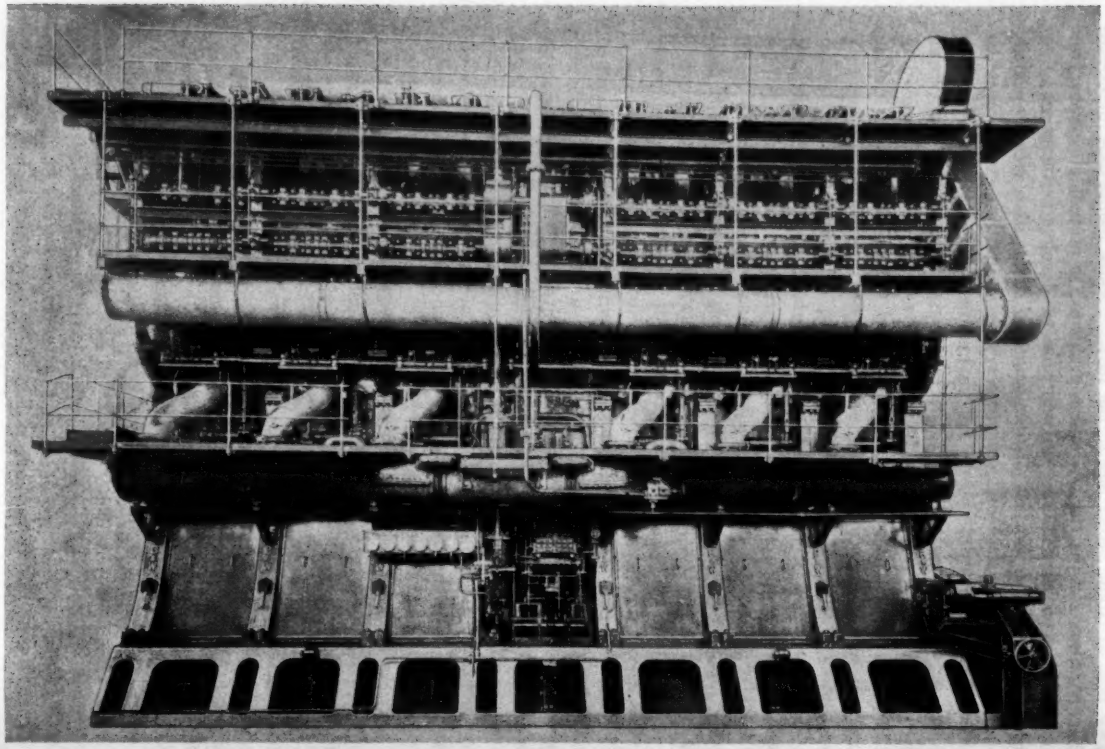
The personnel side of the situation brought out in this paper is of vital importance. To those of us who fought and bled in the early days of destroyers and submarines, the problems of the naval aviator today seem to be minor ones. Every destroyer or submarine captain of the old school can recite stories of ill-treatment on the part of larger ships. These hard knocks are part and parcel of the development of anything new. In the long-run, they help the new development to take its proper place in the general scheme of things. In view of the public interest in aviation at the present time, however, they cannot be allowed to persist. As the author points out so ably in this paper, the Navy's first duty is to eliminate the annoyances under which aviation sometimes has to work. It must get behind aviation and push it to the extreme, if necessary, in order to speed up its development. Aeronautics, in good faith, has attempted to go to sea with the fleet. The fleet should meet it halfway and more than halfway.

To many people with the best interests of the country at heart, a perplexing situation arose in the aircraft controversy. On one hand was the desire to kill the unified air force idea as strategically, tactically and economically unsound from the broad viewpoint of national defense. They feared that in the desire of the country to develop aviation to the utmost by concentrating the authority and responsibility for aviation in one department, it might so divide the responsibility for the conduct of a war among three departments as to bring about a loss of the war. At the same time, they feared that the reaction to the death of the unified air force idea would so retard aviation development, in personnel and material, as to again hamper national defense. The unified air force idea has been dealt a severe blow in the last Congress. The battle is just beginning, however, and the Navy's only reply to public criticism of its conservatism is to go out for more men, more money and more development in aeronautics, with every energy at its command.

It is interesting to note in this regard that control of naval aviation in Great Britain has been, for all intents and purposes, transferred back to the Royal Navy. Apparently, Great Britain has made the unified air force mistake, and has learned its lesson. We can avoid this mistake only through developing aeronautics. This development, insofar as material is concerned, is a function of the Bureau of Aeronautics and it can be depended upon to do its part. Operating developments are a function of the fleet and the fundamental requirement on the part of the fleet is a sympathetic attitude toward aeronautics. Aeronautics needs the helping hand of the fleet, and if this is not forthcoming, the Navy will suffer a staggering setback. It must be remembered that no matter what individual members of the administration may think, public opinion is the all-compelling force

in this country and at present public opinion is adverse to naval control of aviation.

I do not agree with the last paragraph of the article that it is "our duty to the man of Main Street and to the man of shore habitations, neither of whom has time for the study of these problems, to prevent air power from displacing sea power." Our real duty is to develop aeronautics to the highest degree in the shortest possible length of time with a view to utilizing it to full advantage *with* our sea power.



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One of the Burmeister & Wain, Four-stroke Cycle, Double-acting, Reversible Diesel Engines of the "Gripsholm."

PROFESSIONAL NOTES

PREPARED BY

LIEUTENANT COMMANDER H. W. UNDERWOOD, U. S. NAVY

FROM FEBRUARY 23 TO MARCH 23

GENERAL ARRANGEMENT

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GREAT BRITAIN

British Naval History Essays

Army, Navy and Air Force Gazette (British), 14 February, 1925.—Some good and comprehensive subjects have been chosen for the examinations in naval history, open to lieutenants of under five years' standing for the years 1926-29. Elsewhere in this issue there are reprinted the lists of authorities to be utilized in connection with the essays of 1926 and 1927. It may strike some that these lists are not as complete as they might be, but the official policy is rather to restrict them to essential works, easily accessible to the majority of officers. The essays are judged more on the way the facts are presented than on the amount of original research. In one competition, however, an officer who put in several days at the Public Record Office was able to include in his essay information of really remarkable value. There is nothing to lose, and much likely to be gained, from a little spade work of this character. A pamphlet containing suggestions for the essays is issued by the Adviser on Naval Education. Since 1922, no choice of subjects has been allowed in this annual examination.

The subject for the annual examination of junior officers in naval history for the year 1926 will be "Rodney as a Strategist and Tactician." The following is the list of authorities published in fleet orders:

Life in *Dictionary of National Biography* (see also articles on Sir C. Douglas, Hawke, Hood, Howe and Sandwich, 4th Earl).

Life and Correspondence of Mundy.

Life of D. Hannay in *English Men of Action*.

Hood's Letters (Navy Records Society, Vol. III).
Signals and Fighting Instructions (Navy Records Society, Vol. XXXV).
The Barham Papers (Navy Records Society, Vols. XXXII and XXXVIII).
Mahan. *Influence of Sea Power on History. Types of Naval Officers.*
Chapter XXXI in Vol. III of Laird Clowes' *History of the Royal Navy.*
Corbett. *Principles of Naval Strategy. England in the Seven Years' War.*
Castex. *Les idées Militaires de la Marine du* XVIIIme siècle.
Chevalier. *Histoire de la Marine Française pendant la guerre d'independance Americaine.*
Lacour Gayet. *La Marine Militairet de la France sous Louis XVI.*
Hunt. *Political History of England, Vol.* X.
History of the British Army. J. W. Fortescue. Vol. III.

The 1927 Essay

For 1927 the subject of the examination will be "Naval Operations in the Mediterranean from 1793 to the English Evacuation of the Mediterranean, with Special Reference to their Influence on the Campaigns on Land." The list of authorities is:
Mahan. Influence of Sea Power on the French Revolution and Empire. *Life of Nelson,* Vol. I.
Cambridge Modern History, Vol. VIII, or *Cambridge History of British Foreign Policy,* Vol. I.
History of the British Army. J. W. Fortescue. Vol. IV.
Chevalier. *Historie de la Marine Française sous la première Republique.*
Corbett. *Some Principles of Maritime Strategy.*
Collwell. *Military Operations and Maritime Preponderance.*
Nelson's *Dispatches.*
The Spencer Papers (Navy Records Society, Vols. XLVI and XLVII).
The Naval Miscellany, Vol. I (Navy Records Society, Vol. XX. Hood's Letters).
J. H. Rose. *Lord Hood and the Defense of Toulon.*
Laughton. Nelson *English Men of Action.*
Hunt. *Political History of England,* Vol. X.
Dictionary of National Biography (articles on Hood, Hotham, Jervis, Moore, Nelson).
Diary of Sir John Moore (Sir F. Maurice).

Cruisers or Committees?

Army, Navy and Air Force Gazette (British), 21 February, 1925.—Certain inspired statements in circulation during the last few days credit the government with the intention not to lay down any new warships until the possibility of an international disarmament conference in the near future has been thoroughly explored. For this unexpected gesture, the cabinet will receive the approbation of those who really believe that our national safety lies in the conclusion of a sufficient number of pacts or treaties, and in the establishment of certain international standards of naval strength—in the fixing of which countries with little or no connection with the sea have an equal voice to our own, which is entirely dependent upon the ocean communications. Of the sincerity of ministers in taking so sudden an interest in the proposal for another naval conference, in regard to which the American Secretary of State said not so long ago that the moment is not propitious, we say nothing; but it is impossible not to notice that the decision coincides with a movement for cutting down expenditure

on the part of the most virile member of the cabinet, who is supposed to have for his object the reduction of 6d. in the income tax. Whether the people will be saved that 6d., time will show. There would be much more satisfaction felt if the money needed for the fleet really was distributed in this way rather than upon another fad of politicians, agricultural or otherwise.

An argument in support of the "do nothing" policy which at the moment holds the field in regard to ships is that other nations are not getting on with their new cruisers to the extent which was anticipated. This will not hold water, especially coming just after the United States has voted eight more cruisers. The ships which the British Navy needs in the near future, at the minimum rate of five each year, are not required to compete with other nations, but to replace the fabric of the fleet which has become thoroughly worn out by prolonged and arduous war service. No other navy was called upon to perform anything like the amount of work, by night and day, in all weathers, under every conceivable condition, which fell upon our own. The stress of those four and a quarter years has materially shortened the effective life of the cruisers. Coupled with this important fact, there was an interval of nearly six years since the Armistice during which not a single new cruiser was laid down, in contrast to the pre-war practice of adding a few ships each year to counteract the wastage from normal wear and tear.

Those who follow closely the progress of naval affairs know only too well how much the fleet of today stands in need of some new ships, and how much more urgent that need will become as time goes on. One of the cruisers now in service is the *Weymouth*, which, when required for a voyage to China and back recently with a relief crew, had first to go into dockyard hands for defects to be put right, the voyage being delayed in consequence. Despite this, it is now announced that on her return journey the Weymouth has been delayed for three days or more from condenser trouble. Another instance is the retention in full commission on the North American Station of H.M.S. *Constance*. Over two years ago, this ship was withdrawn to Devonport for a refit, and to remain at home, but owing to the stranding of the *Raleigh*—one of those unforeseen contingencies which ought always to be kept in mind—she was sent back to the station temporarily. Since she is still out there, it must be concluded that no ship is available to replace her. The same thing probably affords a reason why the two oldest oil-burning cruisers in the Service, completed ten years ago, the *Cleopatra* and *Carysfort*, are maintained in full commission in the Atlantic fleet, in which they have just been exhibited to the Spanish naval authorities at Ferrol. We have absolutely no reserve of cruisers, and the Conservative Government—true to an old tradition of its early days in office—is not going to provide any yet awhile. It is going first to seek the opinions of the Swiss, the Greeks and the Chinese.

His Majesty's Airships

Army, Navy and Air Force Gazette (British), 28 February, 1925.—The new feature of the Estimates prepared by the air ministry is the inclusion of a sum for airship construction. Although we have lost several years in the development of this important arm owing to a mistaken policy, we are now well on the way to re-establishing these highly useful craft. From the fighting airman's point of view, and quite rightly, the airplane is the real tactical weapon, but there are other considerations which make the airship a unit to be reckoned with.

Firstly, perhaps, is the fact that the air cruiser can increase the airplane's power and radius by acting as a mother ship; secondly, there is the

fleet scouting rôle; thirdly the Army transportation service; and covering all is the commercial use of the airship in peace time as the ideal means of communication between the scattered parts of our world-empire. When a hundred passengers can leave England and reach Bombay during the Friday to Monday week-end, something will have been accomplished to break down the distance isolation of the various states from the homeland; and if a hundred tourists can embark today, a battalion of infantry can be moved by air tomorrow.

The new airships are on order at Cardington and Howden, and old ones are being reconditioned. The stage is experimental, but development is sufficiently forward to accelerate the whole program when needed. H.M. Airship *R 33* is practically ready for service, and will this year collect data in handling airships under tropical conditions, and her route for the purpose will probably be Egypt to India. H.M. Airship *R 36* is also in the fitters' hands, and she will most likely perform the experimental flights on the England to Egypt section of the route. Half a million is scheduled for airship work, and £150,000 has already been paid to the Howden contractors. Each ship will cost about £350,000, and they will be in commission during 1927.

Coming to the combatant arm, the Estimates detail the development of the squadrons, and these number fifty-four. The regular squadrons for home defense now number eighteen, and by this time twelve months the number will be twenty-five. There are 126 airplanes allotted to the fleet air arm, and by the end of the year this number will be raised to 150. Four squadrons will continue to do duty with the army at home, and the overseas cooperation remains as now: namely, eight in Iraq, six in India, and four in Egypt and Palestine.

The provision made for creating a reserve is interesting. Trained men passing to the reserve are becoming fewer, and a start is to be made by direct entry from civil life and to teach these reservists the business of flying. Civil clubs will also be encouraged to embark on a sporting existence. The reserve and auxiliary services have an increased vote this year, and there are five civil schools where training in flight is given. So far as experiments are concerned, the Farnborough establishment is to remain the center, and this year work is to be carried on with a dozen new types. The first of the big coast defense airplanes has passed its test, and its equipment consists of torpedo, bombs, and machine guns, which will provide quite enough work for its crew of three. The cardinal points of a good service are all covered—a strengthened regular arm, a home defense force, an adequate reserve, and plenty of research work.

A British View

Peace Without Security

By Sir Herbert Russell, *The Naval and Military Record* (British), 18 February, 1925.—It is one of the anomalies of the present era that the chief purpose of preparing for war is to prevent war. Today no great power, capable of lighting a terrible conflagration, wants war in the sense in which Germany wanted war in 1914. Certain great powers do, indeed, want sundry very definite things, and undoubtedly they would be prepared to fight for them in the last extremity. But in proportion as they are armed and organized to fight for these things, so they hope to be able to attain their ends without fighting. The strong man always has a very much better chance of getting his way without blows than the puny little fellow who may be safely kicked into the gutter.

A good many perfectly shrewd people are asking why, since the chief purpose of preparing for war is to prevent war, it should not be possible

to prevent war without preparing for it. They are not necessarily idealists because they put this quite logical question. Most of them, indeed, are self-interested economists. It is the prospect of a big reduction in the tax-collector's demand note which really appeals to them. Colossal annual expenditure in order to maintain a negative result does appear rather silly. Unfortunately, there is so much in this very imperfect world which appears rather silly under the test of common sense, so much in the very scheme of nature herself which we can all see (or think we can, which comes to the same thing) might so easily be altered for the better, that, like De Quincey's famous example of the fallacy of logic, this very reasonable argument is untenable. And it is untenable because it takes for granted that which is not true, and never will be true—that human nature has radically changed.

I see that President Coolidge is at it again. He has told the Senate that all Navy bills, appropriations, and every other legislative trick for getting money for armaments, are to be regarded merely as a means to an end. That end is disarmament. He hopes that the crowning achievement of his term of office as president of the United States will be disarmament. But, being too cautious to risk a "bloomer," he is going to watch "the fate" of the Geneva Peace Conference in June next before doing anything further. The words "the fate" are reported as his own: they do not sound very promising in relation to his own aspirations.

Now the present attitude of the United States towards the rest of the world does not altogether illustrate a benign altruism. In fact, so little does it lead to this conclusion, that we may quite legitimately ask why she, of all the nations, is so anxious to see international disarmament. As it is always "My country—right or wrong" with Americans, we may reasonably assume that they look this question from what they themselves would call their own particular "angle." Idealism is not a national trait in the United States. Dr. Woodrow Wilson was made to realize that. Not being idealists, the Americans are not temperamentally a fighting people. No question of courage enters into this statement. They merely hate militarism. It clashes with dollar-gathering. Mammon is their giant; Mars is a nuisance.

If President Coolidge can persuade the Old World to join in this view, he will, indeed, have achieved a signal triumph for the United States. Since the beginning of time inordinate prosperity has ever been a challenge to aggression. In private life it brings the burglar. In civil life it brings the super-tax man. In national life it imposes a heavy obligation to defend possession against the covetousness of envious nations. America has more to gain by international disarmament than has the rest of the world; for the fulfilment of this doctrine would mean the disappearance of any threat to her prosperity. She can better afford the maintenance of armed forces than any other country. But she doesn't want to. Fighting service is unpopular in the states of today. The Navy Department lives in a perpetual problem of where to get men for the fleet, and if William Shearer is to be believed, it has found it impracticable to maintain the relative ratio of efficiency and strength which it laid down for itself at Washington.

There is a small cult in the United States which deplores the present trend of national characteristics; men of wide vision and broad thought, who regard with dismay the ultimate possibilities of the self-sufficiency, self-selfishness, and self-assertiveness which have developed so amazingly since the Great War. America will have nothing to do with the affairs of Europe—but her voice is very much heard in all the counsels of Europe. A distinguished Japanese statesman mildly asked the other day whether America proposes to extend the Monroe Doctrine to China. The real trouble about this sort of thing is that it renders America oblivious to what other countries may be saying and thinking about her. She looks

upon the rest of the world purely out of herself. It does not occur to her that the rest of the world is beginning to look into her with a growing sense of resentment at the combination of aloofness and assertiveness; of "help yourselves, and pay us what you owe—and when you've helped yourselves, perhaps we'll come and help you."

The League of Nations, without America, is admittedly a farce. Disarmament without the acquiescence of all the great naval powers (America does not trouble about armies; they could not reach her without fleets) would not be a farce, but an impossibility. We do not yet know what may happen at the Geneva Conference in June next. All we do know is that the great naval powers are increasing their building programs as though in intelligent anticipation of the result. But I think one thing may be regraded as reasonably certain. Japan is not going to modify her naval policy under the lead of the United States. We are not going to reduce the British Navy to a little sea police force under anybody's lead. Only a handful of Socialists in this country seriously believe in the possibilities of disarmament.

It is of first-rate importance that the political atmosphere of the United States in relation to the rest of the world should be clearly realized if the problems which have to be confronted in connection with disarmament are to be understood. For this reason, I have permitted myself to say very frankly about America what a great many people are thinking but very few, indeed, are saying. Facts must assume their true proportions in any attempt to survey an international question, otherwise we arrive at a distorted conclusion. The pacifist tries to get around this difficulty by explaining away facts. This is where idealism becomes dangerous.

In these prosaic days two primary conditions hold the threat of war. The first, and most potent, is the denial to any country of territory for the expansion of her swelling population. The second is acute conflict of commercial interests. Other causes may bring about a threat of hostilities, but as these are not so likely to appeal to general national sentiment, there is every reasonable prospect that the differences will be composed by diplomatic means. The first-named conditions go too deep for such a solution.

America is very unlikely ever to go to war aggressively. Any conflict in which she plays a combatant part will be forced upon her. No country in the world has so much to defend within her frontiers, since no country in the world enjoys such a vast measure of prosperity. International disarmament, by its implication that the world was prepared to abrogate an appeal to arms as the ultimate decision in disputes, would be of colossal advantage to America. I am not prepared to deny that such a consummation would be of great benefit to all humanity. But to America it would mean relief from the obligation to safeguard her material prosperity against the rapacity born of envy and poverty.

I take the liberty to believe that this perception is uppermost in the mind of President Coolidge. He is such a good American that every policy he formulates is for the advantage of America. If the world outside likewise benefits, that is incidental, and unquestionably President Coolidge would be sincerely gratified. But the welfare of the world outside is not the primary business of the taciturn President of an aloof Republic. Disarmament is his gospel because disarmament would be all to the good for America.

Now, if the United States were consistent and remained the self-contained country she postulates as being by passing the Aliens Restriction Act and by renouncing the League of Nations, and such like things, this attitude would be strictly logical. But she is not consistent in this respect. She will not associate herself with the domestic affairs of the Old World, yet her insistence that we should settle the Irish question was a strange commentary upon her avowed exclusiveness. She will take no hand in the

efforts to solve European problems but there is a United States representative at all conferences to this end. She carries her point upon the limitations of naval armaments—but she makes it very clear that she will brook no competition in her claim to naval supremacy in the Pacific.

With her usual keen business acumen, America appraises the colossal potential value of the markets of China. Sentimentally she does not care a tinker's button as to whether China is partitioned by warring factions or remains intact. Commercially, she does care a very great deal. Adverse exchanges render Eunrope a bad market for her. To maintain and increase her prosperity she must go on expanding her export trade. China is a customer of infinite possibilities: the domestic affairs of that customer are therefore a matter of the utmost moment to America.

But, for physical reasons of a much more urgent character than commercial interests only, China is claiming the attention of Japan. She is committted to a policy of exploitation of Celestial territory and Celestial industry less as a matter of choice than from the impelling necessity of a population too dense to remain much longer self-contained. Japan is under no illusions as to the future. Last year her naval building program was by far the biggest in the world. This year popular indignation has been deeply stirred in Japan by the fact that the scheme of the United States naval maneuvers is based upon the hypothetical objective of conflict with a fleet which could not possibly be any other than the Japanese fleet.

Is this a promising atmosphere in which to talk about international disarmament? Within the serene interior of the White House the prospect may seem feasible enough. But the American "angle" is not necessarily the "angle" of other nations. President Coolidge is proposing the principle of peace without security. He can quote people in this country who are proposing it too. But there is at least this difference: the idealists in this country are adherents of the League of Nations and contemplate acting only in concert with a vast community of peoples. President Coolidge absolutely declines to recognize the League of Nations, thereby postulating that America is an international law unto herself.

It is all very interesting academically, but as a practical proposition it emerges as little more than a ridiculous anomaly. The mere idea of "pooling," or restricting, resources at the behest of a cosmopolitan conclave is an affront to that spirit of self-determination which is the first instinct of nationalism and patriotism. We are living in a queer age, marked by many attempts to distort or destroy values based upon centuries of human experience. But happily the cataclysm which would result from a riot of ideals is as yet a very long way off.

FRANCE

French War College

The Journal of the Royal United Service Institution (British), February, 1925.—*The "École Supérieure de Guerre," Paris*, reproduced by permission of the General Staff. The French Staff College, or *École Supérieure de Guerre*, has long been established in the *École Militaire* on the Champs de Mars, Paris, facing the Eiffel Tower and the Trocadero. The original building was designed by Gabriel for Louis XV in 1751, at the instigation of that ardent builder, Madame de Pompadour. It is a good specimen of the later classical style of French architecture of which Paris has so many fine examples. In these premises are housed the commandant and second in command of the college and a few senior staff officers. They contain the administrative offices, the lecture halls and the library for the college and also the room allotted to the *Centre des Hautes Études*—a war college where six-months' courses are held for senior colonels and brigade commanders. In the adjoining barracks are a regiment of cavalry, some

artillery and stables for the 200 horses which belong to the *École de Guerre*.

The halls of study consist of two large lecture rooms, each with seating accommodation for some 120 officers, fitted with cinema and lantern apparatus, and a number of small rooms, accommodating some ten to twenty officers each, provided with plain wooden desks and hard stools. Everything is designed on a strictly utilitarian basis and in accordance with the sound French policy of getting the last once of value out of the money voted by the Chamber for its army.

The college is designed for purposes very similar to those of the staff college, Camberley: namely, for the training of officers of ages somewhere about twenty-five to thirty-five in the higher branches of the art of war and in the duties of the staff. The entrance examination is competitive and consists of two portions, arranged, so far as possible, to eliminate the crammer's trained competitor. In the written portion candidates are set a limited number of papers, some four or five, one of the most important of which is the preparation of a considered essay on some subject for which the relevant documents are provided. For instance, in one case a mass of diplomatic and other papers dealing with relations between France and Germany between 1870 and 1914 was given to the candidates, who were told to write a paper showing how the relations between the two countries had led up to the Great War. The time allowed for this work was seven hours, during which candidates worked without a break of any kind. This written examination is used to reduce the number of candidates to about 30 per cent of the vacancies available, and the final selection is done by a series of boards of officers, who carry out very rigorous oral examinations on military subjects and in languages. Nothing is laid down as to the proportion of various arms who shall enter the college in each batch or *promotion*, but apparently during the oral examination some rough discrimination as to arms is made.

The list of successful candidates is published in March, and the future students spend the following six months, prior to joining the college in November, in attachments to all arms of the services, excluding their own. Thus, an infantryman is attached to cavalry, artillery and air units, and so on. By this preliminary attachment every officer is placed closely in touch with the latest developments in tactics, armament and administration of each arm of the service and is in a better position to make good use of the teaching which he will receive during his two years at the *École de Guerre*.

The staff is organized into two distinct parts, the *direction des études* and the instructional staff. The commandant is a *Général de Division* or *Général de Brigade*. General Debeney has just vacated this appointment to become chief of the staff of the army. His successor is the former second in command, General Dufieux, at one time Chief of the Operations Section at G.Q.C. General Debeney was a member of the *Conseil Supérieure de la Guerre*, and as this entailed many duties besides those directly connected with the *École de Guerre*, most of the organizing and disciplinary work fell on the second in command. The latter has as assistants a colonel and a lieutenant colonel, whose primary functions are the supervision of the instruction, and two majors *(Commandants)*, one corresponding to a brigade major, the other for administrative work, corresponding to a staff captain. There are other junior officers working under these two latter. The teaching staff is divided into ten courses *(cours)*: viz., staff duties and tactics of all arms *(état-major et tactique générale)*, infantry, cavalry, artillery, fortification, aeronautics, military history, equitation, and various languages, of which the principal are English and German. The *cours* are each in charge of *professors*, usually a full colonel, who is assisted by several assistant professors *(professeurs-adjoints)*, who are lieutenant colonels and

majors. Each *cours* run its own lectures, schemes, etc., the coordination of the teaching of the various arms being part of the functions of the *Direction des Études*. The total staff in 1923 consisted of fifteen officers on the direction and administration duties, and fifty-two instructors.

The *cours d'anglais* is under Lieutenant Colonel Gémeau, a well-known figure at G.H.Q. during the war, as he was attached to the British Commander-in-Chief's staff for several years. There are three French *professeurs-adjoints*, one of whom has also done *liaison* work with the British Army during the war, and one British officer.

Student officers are divided into groups according to their knowledge of the language; work with the senior groups is most interesting and varied, and, as all have a fair and many a good command of English, most interesting discussions can be held.

The students *(élèves)*, of whom sixty to 100 are admitted annually, are for all studies, except reading and languages, permanently organized into groups, each of about ten French and three or four foreign officers. Some thirty to forty foreign officers are admitted each year, and these form a distinctive feature of the *École de Guerre*, and are drawn from most of the allied and neutral nations by nomination by their respective countries and without examination. The following nationalities were represented during 1922-23: U.S.A., Belgium, Japan, Portugal, Rumania, Czechoslovakia, Yugo-Slavia, Poland, Chili, Denmark, Finland, Holland, Spain, Sweden, Switzerland, Siam. Of these, U.S.A., Poland, Czechoslovakia and Yugo-Slavia had from three to six in each *promotion*, while the other nations were represented by one or two only. The Siamese officer was a prince of the Royal House who had been educated at Eton and at the Royal Military Academy, Woolwich, and who up to the outbreak of war, was attached to the Royal Horse Artillery at Aldershot. Many of the Czechoslovakian officers had commanded brigades and divisions in the Legion in Siberia, while the Poles had previously served either in the Russian, Austrian or German Armies. In view of this heterogeneous combination of each group, it may be readily imagined how the discussion of a tactical question brings to light many varied experiences and many diverse mentalities.

The method of instruction differs to a certain extent from that of the staff college at Camberley. Every officer has to ride three or four times a week, and this takes place at seven or eight A. M. On three days a week the second and third hours from eight to ten are devoted to languages, English and German being taken by most officers, though certain other languages can be taken, such as Polish or Russian, etc., in lieu of English. At 10:15 there is a lecture to the whole of a *promotion* in one of the large lecture halls. This lasts until 11:15 or a little after, at which time all officers are more than ready to go home to *déjeuner*.

Owing to the college being situated in the middle of Paris, it is difficult to spread the outdoor schemes over the whole year, as is done at Camberley, and, with the exception of a few days in autumn and spring, outdoor work is carried out during the summer in the form of staff tours *(voyages)* in the country.

On an average two afternoons a week are devoted to work of various natures at the school, starting at two P. M., finishing at five or five-thirty P. M. An *exercise sur la carte* consists of a tactical scheme worked out on the map by a group under an instructor, and is somewhat on the lines of a Camberley *allez-allez* scheme, but done entirely indoors. The scheme is issued some days previously, and all students are supposed to be fully acquainted with its details and to be prepared, on arrival at the hall of study, to answer any questions and give decisions in any rôle which may be allotted to them. These decisions, etc., are then criticized by the professor, and after some discussion on relevant points, the narrative of the opera-

tions is continued, and the instructor calls on the students for further decisions and orders, etc. Another form of afternoon work, called *travail en salle,* is the preparation of orders by each individual officer. Certain details only having been issued previously, the special idea and the work required are communicated to officers on their arrival and the task has to be completed in three hours. As French orders are generally long and the work that is set for three hours in the afternoon is generally that which would be undertaken in the field by several different officers in a longer time, the mental state of the students by five o'clock is invariably one of exasperation and disappointment. Owing to the pressure at which they have worked and the feeling that they have failed to do themselves justice, they consider that their instructors are very hard on them. This state of mind is fully realized by the instructors, whose aim in setting some five hours' work to be done in three hours appears to be not so much to attain the impossible as to train officers to think and work quickly and in a somewhat rattled state of mind.

In addition, a series of schemes to be worked out at home *(travaux à domicile)* are set during the winter months. As a rule these are issued on the Saturday morning and have to be handed in on the following Monday week, and may entail anything from twenty to fifty hours of hard work. Each of the principal *cours* sets one such scheme during the period from November to March, and these are superimposed on the other work already described.

Students join in November, have a few days' leave at Christmas, a few days at Easter, and work straight through until the middle of May on the program outlined above, with the addition, during November, March and April, of a few outdoor schemes in the country round Paris. By the middle of May the officers are in a highly "crammed" state, and the beginning of the summer season of staff rides or *voyages* is most welcome. During the first year's course each officer does three such staff rides *(voyages d'armes),* run by the infantry, cavalry, artillery and military history *cours* respectively. In addition, he spends three weeks visiting the frontiers of France from Lake Geneva to the Belgian frontier.

For these tours two groups of officers (about thirty officers) work together in charge of some four or five officers of all arms from the instructional staff. The party proceeds to the first billet by rail, where it is met by a detachment of grooms and orderlies with horses for all. Work starts at six o'clock each morning, by which time all officers, with a proportion of horse-holders, are mounted in the square of the village in which they are billeted. The day's work is on the lines of the traditional *allez-allez* scheme, successive situations being issued by the instructors as the work proceeds. At twelve noon the party returns to *déjeuner,* after which a few hours are devoted either to sleep by the lazy ones or to the preparation of orders, etc., by the unfortunate or the energetic. At five P. M. all meet for a conference on the morning's work; this generally breaks up at about six or six-thirty P. M. Dinner is at seven P. M., and most of the officers go to bed very soon after in view of their early start next morning. These tactical courses last about a week, with one day's rest in the middle. As a rule, during a *voyage d'infanterie* two days are devoted to the defensive, one day to an approach march, two days to the preparation and carrying out of an attack, and the last day to *exploitation* or pursuit. Somewhat similar allotment of time obtains for the artillery and the cavalry schemes. Billets are changed every third night as by French law free quarters may be demanded for not more than three consecutive nights. The horses which are borne on the establishment of the *École* spend the whole summer on tour, moving from village to village, and provide mounts for some fifteen of these *voyages.*

In addition, there are military history tours of three days only, which are devoted to the study of one of the battles of the Great War. During 1922-23 the battle of the Ourcq was studied in the greatest detail by the first-year and the battle of July 18-22, 1918, by the second-year students, and very useful lessons derived therefrom. The transport of this tour is carried out by motor and charabanc.

During the the second year the tour of the frontier is completed, and a visit is made to certain munition factories. The principal tour consists of a staff ride lasting fifteen days, during which a series of tactical situations are worked out in detail. The student officers hold all posts on the commands and staff, from that of corps commander downwards, and an immense amount of valuable work is done during this tour. All feel that on their work during this tour depends the order of the final reports and of other subsequent appointments; there is good reason for thinking that the students are right.

These tours end about the middle of August, after which all proceed on leave until the next November, when the seniors are posted to appointments on the staff and the juniors return for their second year. Officers are free to proceed to their homes in the intervals between the tours, so the total amount of leave during the year is on a liberal scale.

Another valuable feature of the course is a series of lectures by distinguished publicists, professors and other students of foreign policy. These lectures are attended by all the students and by the officers of the *Centre des Hautes Études.* They deal with many questions of foreign policy, both European and Asiatic, and the general tendency is to show France as the one bulwark of civilization on the continent of Europe. Criticisms of British policy are both frank and free, but as a rule are made in a very fair spirit. In one remarkable instance a lecturer was heard to compare the methods of British and French diplomats and soldiers at the conference table, ending with a conclusion strongly in favor of the British method.

The life of the students forms a striking contrast to that of British officers at Camberley, for there are no quarters in the school, nor is there any mess in our sense of the world. The majority of the officers are married and have to find accommodation as best they can in and around Paris, and this is no easy matter, as the demand for flats is very much greater than the supply.

Although there is a gymnasium and fencing hall, which is very well attended, there are none of those collective games that form such an important part of the life at our staff college, and this deprives officers of many opportunities of knowing their fellow-students. Few, if any, of the students know, even by name, all the officers in their own *promotion,* while many who are of a quiet or retiring disposition meet the officers of their own group, together with those of the allied group with which they go on tour, and practically no one else at all. This is one of the great drawbacks to the French system, for the excellent spirit of *camaraderie* which is fostered by Camberley cannot be produced to anything like the same extent. These conditions are, perhaps, complicated by the presence of the large number of foreign officers. These are welcomed by the students and are treated in every way similarly to the French officers, being admitted to all lectures except a very small number dealing with mobilization, yet their presence naturally acts as a restriction on perfectly free discussion, more especially on all personal matters.

The problem which faces the French staff is entirely different from that on which training in this country is now based. The French envisage a Continental war over a land frontier with large armies in contact almost from the beginning, and the bulk of the teaching is directed along these

lines. During the first year the tactics and staff duties of a division and its component parts are thoroughly studied, and in practically all schemes this division is considered as one of many, with both its flanks protected by other troops: i.e., *encadré*. During the second year the army corps forms the basis of study, and in most cases this is also treated as being *encadré*. For any important attack it is always assumed that artillery and ammunition at least on the scale of 1918 is available, and a high proportion of air force is always allowed as being available.

The greatest importance is attached to questions of inter-communication and *liaison*, which are studied in the minutest detail in all schemes. Further, every officer has to write orders not only as a corps or divisional commander for the air force working under him, but also as an air officer commanding a formation or unit of the air force. The French do not allow that there is any mystery in the work of handling of air forces which cannot be grasped by officers of other arms of the service.

The knowledge of detail which is amassed during the course by all officers is remarkable. During the final *voyage* the volume of facts as to tonnage of ammunition, carrying capacity of transport units, etc., which students, holding positions as artillery or administrative staff officers, produce without reference to books is amazing.

Possibly there is too great a standardization in the methods of warfare contemplated, but there can be no doubt that the *École de Guerre* is arriving at the goal of Moltke's ambition for his Great General Staff: namely that a problem set to any number of his officers would produce the same number of practically identical solutions.

French Naval Outlook

The Naval and Military Record.—The naval outlook is getting rather gloomy. Although the good-intentioned Minister Dumesnil has done much to suppress religious practices in the naval service and otherwise "republicanized" the navy, the pro-German and pro-Sovietic majority of the Chamber view him as being too patriotic, and he will have some difficulty in carrying through his naval program, though many others deem it inadequate of French needs. Judiciously enough, preparations are made for the eventual taking in hand either of 35,000-ton ships or of 17,500-ton cruisers. The 2,400-ton *Lynx* is to be launched on the twenty-fourth inst. at St. Nazaire. A riot has just been nipped in the bud in Tunis, and Bocho-Bolshevist unchecked propaganda is making for trouble.

Within the next few weeks two destroyers are expected to run their preliminary trials: namely, the *Jaguar*, completing at Lorient, that is much belated, and the *Tigre*, completing at Nantes. The last-named, in hand at the Chanliers de Bretagne (a firm reputed for that branch of work), made rapid enough progress, having been ordered fifteen months since and launched last August. She is now practically completed, with her five boilers and two Rateau turbines installed on board, as well as her three funnels, of which two are very large, and most of her superstructures, that are very commanding and contribute to transform the six *contre-torpilleurs* of the *Tigre* class into cruiser-like targets, even more so than are the fine British flotilla-leaders of the *Broke* type. On the other hand, if the seaworthiness of the *Tigres* is in practice what is now expected, they will be, in the matter of comfort, habitability, and sea-keeping power, infinitely superior to anything in the destroyer line existing in the French Navy, and superior probably also to the latest destroyers of other navies.

In this important respect they embody the lessons of the war. French 700-900-ton *contre-torpilleurs* that were the principal element of the Allied blockade of the Austrian bases in the Adriatic proved rather unsuited for trying blockading cruises in all weathers, from their small size, poor con-

ditions of habitability, and insufficient radius of action. The new 2,400-ton *contre-torpilleurs* are not open to reproaches of that sort, being in reality more roomy than one might infer from their displacement with wide space on their forecastle and deck, spacious crew quarters, officers' cabins and kitchens, and even ample room and up-to-date ventilation in the engine and boiler rooms, that occupy comparatively small space when is considered the tremendous propelling power: namely, 50,000 h.p. nominally, but which, to judge from stationary boiler trials, will in reality exceed 60,000 h.p., thus by far the largest motor power ever developed in flotilla units. This means that our new *contre-torpilleurs* will be scouts for all practical purposes, at least should the structural robustness be equal to the fearful strain when ploughing at over 30 knots through heavy seas. Their radius of action will extend over 2,500 miles at 18 knots and over some 3,500 miles at 15 knots.

The forthcoming trials are being awaited with interest in the service. It is remarkable that both units to be first ready (*Jaguar* and *Tigre*) are fitted with the Rateau turbine, as is also the *Chacal*, whereas the three others (*Lespard*, *Panthere* and *Lynx*) have Breguet turbines. Obviously, the principal quality of these systems of turbines is to be French; naturally enough, the Paris Admiralty believes in supporting home industries. At the same time, service experience has been constantly in favor of Rateau turbines as fitted in the *Voltigeur*, *Fourche* and *Faulx* destroyers and in a dozen cargo boats or liners; and so much so that, as the result of comparative experiments, the Minister of Marine (whose motto is: "Choose the best materials and patents if possible, but the best") has just ordered for our two 10,000-ton cruisers *Tourville* and *Duquesne* two sets of Rateau turbines of 260,000 h.p. altogether, to be manufactured at the Nantes Chantiers de Bretagne, that are also to make the eighteen boilers for the same—a truly remarkable order. The three 8,000-ton cruisers approaching completion (*Duguay-Tronin*, *Lamotte-Piquet* and *Primauguet*) have Parsons turbines working on four shafts. Useful comparisons will be made at sea two years hence.

French *ingenieurs*, whose predecessors have so often in the past led the way in the matter of ship propulsion (having been first with steam and tube boilers), intend no longer to lag behind Great Britain and Germany in that important respect. An energetic effort is being made that is bound to give momentous results. Already France is holding her own in the matter of turbines and also of aviation motors (after being behind England for years). She is now tackling in earnest the internal combustion motors, private firms cooperating with the Admiralty in that direction, and Nantes-St. Nazaire being the main center of experimental studies.

French aviation is dashing ahead wonderfully, showing to the world that the country that did pioneer work in the air retains still some predominance in that element by virtue of her skilled and fearless aviators and of her well built and reliably motored flying machines. Colonels Vuillemain and de Goys, together with Captain Pelletier-Doisy, of Paris-Tokyo fame, are well through their 8,000-kilometer African cruise. Two other officers, Captains Lemaitre and Arrachard, have just flown at a stretch from Paris to Port-Etienne (4,000 kilometers) in one of those famous army standard Breguet machines of medium size and power, modest enough on paper and to look at, but the superiority of which is revealed in practice: namely, smooth and reliable engine working, perfect conditions of stability and handiness, together with simplicity in construction and all-round fittings. Their Breguet nineteen-biplane, similar to that used by Pelletier Doisy, is a small bombardment machine with a single 480 h.p. Renault engine and a total weight at full load of three tons and a quarter (of which nearly two tons of bombs in armed service). Even more important from a naval

standpoint is the performance just accomplished by a second batch of three large seaplanes (ninety feet span, 800 h.p.), which under Lieutenant de Vaisseau Aubert, a gallant officer with creditable war records, accomplished without a hitch the flight Toulon-Bizerta in about five hours, stopping at Karouba.

As, moreover, a regular aerial line is commencing to work from Corsica to Bizerta, the problem of safe communications with Algeria in war time is considered to be to a certain extent solved. All this is satisfactory so far as it goes, but there are, unfortunately, signs that Germany is silently forging ahead in the air at a faster rate than is France. She has ten times the capabilities of France in the matter of manufacturing plant and of training resources, and—last, but not least—her chemical production capabilities excel those of all ex-Allies combined. So far as numbers are concerned, Italy outmatches France in the air in the Mediterranean zone.

The ministrial decision to create a station of bombardment seaplanes at Querqueville, near Cherbourg, is justified by the legitimate desire to utilize the strategic advantages which the great Norman peninsula and promontory possess for the control of the Channel. Avions de combat based on La Hogue and La Hague would outflank hostile squadrons attacking La Hâvre and St. Malo-St. Brieuç, Experts, however, realize—despite the fact that a conflict with England is considered as impossible—that the proximity of the English Channel Islands depreciates the strategic worth of Cherbourgh and even of Brest, and furnishes an argument for developing the La Pallice-Rochefort base, that is, under the new conditions, the safest of French naval roadsteads, being procted from high sea attacks by two large islands. A new island strategy has sprung up from ballistic and aerial developments. which explains, for instance, that Pantellaria islet is a thorn in the side of Tunisia.

Will the French dirigible fleet revive? Signs are not wanting to supply an affirmative answer. Our dirigibles, which the *Dixmude* catastrophe caused to be put out of commission, have resumed training. German and American go-ahead experiments have restored confidence in lighter-than-air machines. And now the scholarly Colonel du Plessis de Grenedan, the father of the heroic commander of the *Dixmude*, is coming to the rescue of the dirigible cause with a formidable broadside of convincing arguments mustered in a pugnacious volume.

French Estimates

The Journal of the Royal United Service Institution (British) February, 1925.—1925 ESTIMATES.—Submitted to the Chamber of Deputies early in December, the French Navy Estimates for 1925 amounted to 1,300 million francs, or about £15,500,000, being approximately equal to those for 1923 and 1924. The main objects in view were stated by the reporter on the Estimates to be the regular progress of new construction, the reorganization of the shipyards, the strengthening of the fleet air arm, and the reconstitution of the *personnel*.

PERSONNEL NEEDS.—Improvements in pay and in service conditions are intended to attract more men to the Navy. Conscription and the voluntary system combined to furnish the 50,000 men needed in past years, but the decline in the total of volunteers has obliged the taking of men from military service, whose term of engagement is too short to permit of their becoming valuable afloat. Special methods of advertising the advantages of naval service beyond the seaport towns have been adopted.

FLEET STRENGTH.—Reconstruction over a period of twenty years is planned, the ultimate standard, based on the Washington Treaty, being 178,000 tons of ships of the line; 360,000 tons of light surface craft; 65,000 tons of submarines, or 90,000 including those for coast defense; and 150,000 tons of special vessels, submarines, minelayers and auxiliaries. Twenty

years is taken as the effective life of ships of the line, aircraft carriers and special craft; seventeen years for cruisers; fifteen years for destroyers, and twelve years for submarines.

MODERNIZATION OF SHIPS.—The modernizing of the battleships was begun in 1922, with the *Provence* and *Lorraine*, and will be completed in 1926. In 1925 the *Bretagne's* 13·4-inch turret guns are to be given increased elevation. Six of the latest battleships are to be equipped with 75-mm. A.A. guns with high muzzle velocity and a number of 40-mm. AA. automatic guns. These ships are also having their fire control system brought up to date. The alteration of serviceable submarines will be completed by the end of 1926.

TEN THOUSAND-TON CRUISER BUILDING.—Two new cruisers, the *Duquesne* and the *Tourville*, have been laid down. They will displace 10,000 tons, have a length of 607 feet, beam of sixty-three feet and a speed of 33 knots. Their armament will consist of eight 8-inch guns, mounted in twin turrets, eight 2·9-inch A.A. and eight 3-pounder guns, with six torpedo tubes. Only the conning tower will be protected. Four airplanes will be carried and launched by catapults.

NEW DESTROYERS.—Names have been chosen for the six 1,500-ton destroyers recently ordered as follows: *Railleuse, Palme, Mars, Fortuné, Alcyon* and *Adroit*. These were names of ships commanded by Jean Bart. The new destroyer, *Ouragan*, was launched at Blainville, Caen, on December 6. She is one of twelve vessels of 1,378 tons, 30,000 horsepower and 33 knots speed, armed with four 5·1-inch guns and two 2·9-inch anti-aircraft guns, with six 21·7-inch torpedo tubes. The radius of action at 15 knots is 3,000 miles.

Unemployment

The Engineer, 13 February, 1925.—The question of unemployment is beginning to occupy attention, at all events in the devastated regions. In the Lille district alone 10,000 men are out of work, and, as it appears probable that reconstruction operations will be entirely suspended, the situation is becoming serious. It is proposed to send out of the district all the foreign workmen who were induced to come into the country at a time when sufficient hands could not be found to carry out the work. The Federation of Contractors is to meet to discuss what is to be done in view of the decision of the government to pay for reconstruction work in bonds redeemable in ten years. As the bonds can only be realized at a heavy discount, no one will accept them, and the federation affirms that unless better conditions are offered all reconstruction work will be suspended, and that would mean that a large army of men would have to find employment elsewhere. Unfortunately, the industrial situation throughout the country generally is so uncertain on account of the money stringency that it will scarcely be possible to absorb all the men from the devastated areas. The minister for the liberated regions is endeavoring to find the funds necessary to prevent what threatens to become a serious crisis.

Refloating the "Liberté"

The Engineer, 20 February, 1925.—After working patiently for three years upon the wreck of the battleship *Liberté*, which blew up in September, 1911, with the loss of more than 400 lives, the hull has been floated and removed from the place in Toulon Harbor, where it was for so long a time a hindrance to navigation. It sank on a mud bottom in front of the Monisséques. Everything possible was removed from the wreck and the superstructure was cut away, and when only the empty hull was left it was made air-tight and raised by compressed air. It was then attached to the

old cruiser *Latouche-Tréville,* which had served as a workshop during the operations, and was towed for 1,500 m. to the dry dock where it is to be broken up.

Synthetic Fuels

The Engineer, 6 February, 1925.—The *Comité Scientifique du Pétrole* is carrying out a very exhaustive inquiry into the work accomplished by the laboratories and other research bodies in the synthetic production of fuels. Very satisfactory results are reported to have been obtained by the laboratory instituted by the oil interests, with the participation of the state, as well as by the *Service des Poudres,* which has of late years given much attention to methods of producing alcohol synthetically. The committee has also received an encouraging report from Professor Mailhe, of Toulouse, who claims that sufficient progress has been made with the economical treatment of vegetable oils with catalysers to warrant the belief that the production of fuels from vegetable oils on an industrial scale in certain African colonies is on the verge of realization. At the same time a communication has been made to the *Société de Chimie Industrielle* on the results obtained with the synthetic production of alcohol by the *Société Nationale des Recherches sur le Traintement des Combustibles* which, by means of a new catalyser, has secured pure methanol from a mixture of carbonic oxide and hydrogen at a temperature of 275° C. and under pressures of between 100 and 200 atmospheres. It is claimed that motor spirit can now be obtained on an industrial scale from coal and other solid fuels.

GERMANY

Germany to Train 2,000 Pilots

Aviation, 2 March, 1925.—It is known that Germany is doing everything in her power to rebuild, under the guise of civil flying, that air power of which she was deprived by the peace treaty of Versailles. Just now active propaganda is being made of the "Nine Rules" laid down by the Interallied Aeronautic Control Commission which limits the performance of German civil aircraft so they may not be camouflaged military aircraft. As, under the terms of the peace treaty, Germany on January 1, 1925, reacquired full liberty of action in aeronautical matters save for the Nine Rules, she is endeavoring to have them abrogated or considerably modified, at any rate, by using reprisals against Allied civil aircraft. Already two years ago Germany decided to seize every French air liner that would have a forced landing in Germany, as a result of which fifteen ships of the Franco-Roumanian Air Line have so far been confiscated. British aircraft were for a time given preferential treatment in the hope that England would exert its influence with France to lift the restrictions of the peace treaty, a surmise which does not seem to have been entirely unfounded judging by the tone of some English aeronautic publications in dealing with this subject. As a result English air liners were permitted to operate between Berlin and London, but now Germany has abrogated this understanding and threatens to seize any Allied aircraft which does not conform to the Nine Rules.

While this wrangle is going on, news comes that one of the most important German aeronautic associations, the Deutscher Flugsport, has launched upon an ambitious program to rebuild German air power by the training of 2,000 pilots within the next two years. The reason given for this sudden activity which does not seem justified by the present development of German commercial aviation is to spread "airmindedness" among the German youth. As four-fifths of the flying pupils will be recruited from among the nationalistic and militaristic associations which exist

allegedly for the furtherance of athletics (forty per cent from the *Wehrkeiskommandos,* or "defense commands," twenty per cent from the *Stahlhelm* and ten per cent each from the *Bismarkbund* and the *Jung Deutscher Orden*), while only one-fifth of the pupils will be accepted on a paying basis, it will be seen that particular attention is paid to the political affiliations of the future pilots.

The instruction of the "well thinking" pupils will be paid for in part by the German Government, which will grant each flying school an annual subsidy of from 80,000 to 120,000 gold marks, and in part by commercial, industrial, agricultural and patriotic associations. Instructors will be chosen among former war pilots. Three kinds of pilots certificates will be issued by these schools: the first will cover primary flying, the second, advanced flying corresponding to an army pilot's instruction, and the third, acrobatic flying equivalent to pursuit instruction.

The equipment to be used will consist of one-place light planes with thirty-five h.p. engines and two-place sport planes with engines of from forty-five to seventy h.p.—all types which Germany is authorized to build under the Nine Rules. The ships in question include the *Albatros, Dietrich-Gobiet, Stahlwerk Mark* (*Rieseler*) and *Udet.*

The Demolition of the Harbor and Defense Works of Heligoland

Engineering, 20 February, 1925.—The author describes the arrangements made, and the methods adopted, consequent on the decisions in the treaty of peace between the Allied and Associated Powers and Germany, signed at Versailles on June 20, 1919. The general arrangements for carrying out these decisions were placed under the control of a Naval Interallied Commission, which deputed the supervision of the works of demolition to an Admiralty Naval Subcommission, the engineering work being supervised by the Civil Engineer-in-Chief's Department.

The subcommission arrived in Heligoland on February 25, 1920, and was withdrawn in September, 1921; the subsequent completion of the outstanding items of demolition work was carried out under the superintendence of the Main Interallied Commission in Berlin, assisted by a representative of the Civil Engineer-in-Chief's Department at the Admiralty, who paid periodical visits of inspection until the completion of the program which had been drawn up by the subcommission before its withdrawal.

It is believed that the work involved is by far the largest work of deliberate demolition ever undertaken, comprising the rendering ineffective of harbor works and fortifications which had taken upwards of twenty-four years to construct, and had cost approximately £35,000,000 sterling. The author first gives a short description and history of Heligoland. The island lies about fifty-seven miles from the entrance to the Kiel Canal, and is about one mile long by one-third mile broad, rising on nearly all sides vertically out of the sea to an average elevation of 170 feet above high water. The elevated plateau is known as the Oberland, while the small area at the foot of the cliff at the southeast corner of the island, where the only town exists, is known as the Unterland.

When Germany obtained possession in 1890, an extensive scheme was initiated for the construction of an outer harbor, to be used largely as a base for submarines, on the Unterland, and heavy fortification works, with underground barracks, hospitals, power stations, and so forth, all hewn out of the solid rock on the Oberland. The rocks comprising the island are of Triassic age, Bunter sandstone, Keuper, Lias, Oolite, Muschelkalk and chalk (now denuded), topped by Pliocene (the "brown rock"). Strata of the Neocomian series are exposed, not in the cliffs of the present island, but in certain banks visible at low water, and show the remarkable nonconformity with the cretaceous.

The demolition of the electric power houses, of the inclined tunnel leading to the fortifications on the Oberland, and of the fortifications and underground works on the Oberland are not described in detail.

The original German estimate of the time required to carry out the demolition was seven years, but after the arrival of the subcommission at Heligoland, and after further consideration, the estimate was reduced to three years, which was found to suffice, owing to the efficient manner in which the work was undertaken and carried out. A list of the items comprised in the fortifications and harbor works is given in the paper, and details of the original construction of the main items of the harbor works and the methods of demolition employed are stated in full.

Statistics give details of the cubic measurements of concrete and brickwork of each item demolished, linear feet of holes drilled, total weight of explosives used, quantities of explosives used per cubic yard of materials, and the cost in man-hours per cubic yard of concrete, and so forth, demolished. The total quantities of concrete and brickwork demolished in connection with the harbor works amounted to 195,435 cubic yards, and of timber cribwork with stone and sand filling, 53,416 cubic yards.

German Shipowners Discredit Rotorship

The Nautical Gazette, 2 March, 1925.—The North Sea voyage of the *Buckau*, Anton Flettner's rotorship, has failed to convince German shipowners of the economic advantages of this new method of propulsion. In a statement issued following the return of the *Buckau* to Cuxhaven from Leith, the Association of German Shipowners declared that the vessel's voyage to Scotland and return has proved that, for the present at least, the rotorship is not of superior economic value as compared with regular sailing vessels.

The statement says the rotorship, while not making any reduction in the crew possible, has not registered any material saving in fuel. According to the asociation's figures, all the saving registered by the *Buckau* did not exceed $6.30 a day, or less than two per cent. The *Buckau's* latest test, the association says, therefore does not justify the substitution of rotorships for sailing vessels.

Marine insurance companies have decided that a higher premium is necessary on rotorships, following the first long voyage of the *Buckau*. According to advices from Hamburg the underwriters are of the opinion that considerable improvements will have to be made in the rotorship which they do not consider practical at present.

Anton Flettner, however, intends to continue his experiments with rotors and the city of Berlin has come to his assistance by granting him a plot of ground in the west end of the city on which two experimental wind towers will be erected. Flettner will conduct experiments with these towers to test the practicability of developing electricity by the rotor system. The first tower to be built will be 120 feet high and will be ready next month, while the second one will be 310 feet high and will be completed by August.

UNITED STATES

VESSELS UNDER CONSTRUCTION, UNITED STATES NAVY—Progress as of February 29. 1925.

Type Number and Name	CONTRACTOR	Percent of Completion Mar. 1, 1925 On Total	Ship	Feb. 1, 1925 On Total	Ship	Contract date of Completion	Probable date of Completion
	AIRPLANE CARRIERS (CV)						
2 *Lexington*	Beth. SB Cpn. (Fore River)	59.6	55.1	58.5	54.		12/15/26
3 *Saratoga*	New York S. B. Cpn.	59.4	57.9	58.	56.4		11/1/26
	AUXILIARIES Sub. Tender						
No. 3, *Holland* (AS3)	Puget Sd. Nvy. Yd.	61.	56.7	58.	53.5		1/1/26
	SUBMARINES						
155 *S-44*	Elec. Boat Co. (Quincy)	Comm. 2/1		6/25			
156 *S-45*	Elec. Boat Co. (Quincy)	98.1	98.1	97.1	97.1	7/15/23	3/–/25
157 *S-46*	Elec. Boat Co. (Quincy)	96.	96.	94.5	94.5	7/15/23	5/–/25
158 *S-47*	Elec. Boat Co. (Quincy)	96.6	96.6	96.6	96.6	8/15/23	6/–/25
	FLEET SUBMARINES						
164 *V-2* (SF5)	Portsmouth N. H. Nvy. Yd.	86.	85.2	83.	82.2		8/1/25
165 *V-3* (SF6)	Portsmouth N. H. Nvy. Yd.	68.2	67.	65.2	64.		2/1/26
166 *V-4* (SM1)	Portsmouth N. H. Nvy. Yd.	.9	.9	.5	.5		4/1/27

Authorized but not under construction or contract—

Authorized by Act of August 29, 1916.
Destroyers (12) Nos. 348—359.
Transport (1) No. 2.
Fleet Submarines (5)—Nos. 167-171.
Neff Submarine (1)—No. 108.

(Funds have been provided by the Act of February 11, 1925, for starting construction of two of the fleet submarines.)

Authorized by Act of December 18, 1924—

Light Cruisers (8)—Nos. 24-31.
River Gunboats (6)—Nos. 43-48.

(Funds have been provided by the Act of March 4, 1925, for starting construction of two of the light cruisers and the six gunboats.)

Naval Cuts First, Is Coolidge Plan for Arms Parley

The Washington Evening *Star*, 14 March, 1925.—President Coolidge's impending call for a second disarmament conference will propose that it take up naval limitation where the Harding-Hughes conference of 1921-1922 left it off. The Coolidge-Kellogg parley, in effect, will deal with the unfinished business of the first Washington Conference. America again will take the lead in making propositions and offering sacrifices. Because the United States Army and land establishments are already down to the bone, this government will submit no suggestions of a reduction in military armaments. As the President puts it, we have nothing to lay before other powers in that direction in which we could ask them to match our efforts. What the United States will do at the next conference, if it can be convened, is to propose:

1. That the naval powers agree, on lines of the first Washington Treaty, to limit the number and size of light cruisers and other surface craft, including destroyers, for a certain number of years.

2. That submarines be abolished, or, if they cannot be abolished, that they be limited in number, and that rules for their use in warfare, especially against merchant vessels, be restricted in the most rigid manner.

3. That the Washington Treaty provisions limiting the total tonnage and armament of aircraft carriers be extended.

The Coolidge administration will pursue the same cautious preliminary tactics regarding a conference that enabled the Harding administration to bring about the first meeting. Several months of the most confidential soundings—at the White House they are now referred to as "approaches"—took place in London, Tokio, Paris and Rome in the winter and spring of 1921 before President Harding moved. On July 10 Secretary Hughes announced that the President had finally made up his mind to seek a conference. Then ensued still another month of soundings, in order that agreement might be reached with foreign governments about the wording of the call. On August 11 the formal American "invitation" to the conference was issued. Then there were three months of negotiation about the matters to be discussed at the conference.

As there are notoriously serious difficulties to be overcome before another conference can be arranged, it is certain that as many months of "approaches" will be required as were necessary four years ago. Secretary Kellogg will await advices from Hugh S. Gibson, American Minister to Switzerland, as to definite collapse, or otherwise, of the League of Nations conference project before making moves of any kind.

The moment the league's plan may be considered abandoned President Coolidge and Secretary Kellogg will make their first "approaches" abroad. These will be informal and confidential. Nothing is likely to leak out about them until they are on the verge of finality. Under the best of conditions, it would be August before a conference would be conveyed. It probably would be October or November, especially if it is decided that Washington shall be its scene. Mr. Coolidge is not determined the conference shall take place in America, though he considers Washington is the best place for it. Europe may ask for a change of venue from the seat of the first conference. The United States would interpose no serious objection to such a proposal.

France and Japan are considered to be the countries from which real obstacles to the holding of another conference may be raised. Neither of those governments is opposed, in principle, to a conference. But both are determined not to enter it except under farther-reaching advance assurances on certain issues than were given in 1921. Having turned its back on a battleship and battle cruiser program for naval defense, France now relies entirely on destroyers, submarines and aircraft. The French contend that with a powerful "auxiliary craft" navy of such weapons they always can command the respect of Great Britain. The French also maintain that they always must have powerful destroyer, submarine and air forces to safeguard the Mediterranean lines of communication with their African dominions, upon which they must in future rely more than ever for raw materials and for native troops.

Japanese newspapers received in Washington during the past day or two show that Nippon is actively discussing the possibility of another disarmament conference. But it is plain the Japanese will come to such a conference with some irreducible demands. The tone of their leading journals indicate that the Singapore base which Great Britain is building has become as much a thorn in the Japanese side as America's exclusion of Japanese immigration is. The Mikado's government, through Admiral

Takarabe, has announced that "the preparation for a second conference must be made with much greater caution than was done on the occasion of the first conference." Admiral Takarabe says that unless there are guarantees against "disappointments," such as ensued after the Washington parley, "an evil atmosphere will necessarily develop that will certainly go far toward destroying the beneficial effects of the first parley." The Japanese press interprets "guarantees against disappointments" to mean some sort of satisfaction to Japan for Singapore and for American exclusion of Oriental immigrants.

Coolidge Believes Time Ripe for Definite Action on Armament Cut

While awaiting more complete and authentic advices concerning the disarmament situation abroad, President Coolidge believes recent developments there, as already indicated, have opened the way to a more definite approach to the project of another arms limitation conference to be called by the United States.

As soon as more definite advices are in hand as to the effect of recent developments at Geneva concerning the League of Nations' disarmament and security protocol, the President purposes to give close attention to the matter in conference with Secretary Kellogg. Any step approaching a formal presentation of the conference idea to the nations interested, however, will await a survey of the situation on the basis of more authentic advices to be received through official channels.

As yet, there has been no actual approach to any of the powers on the subject, and the conferences planned by the President with his Secretary of State will, in fact, be the initial move in getting the many preliminaries attending the project under way.

While it will be for these discussions to determine the plan of procedure, Mr. Coolidge at this time favors a simultaneous approach to the various powers. Under such a plan it would then remain for Secretary Kellogg to lay the project before the governments at London, Paris, Rome and Tokio through the American Ambassadors there, with the reaction of each to be reported to Washington. While hopeful that it would be favorably received by each of the governments, it is the present intention of President Coolidge that, in the event of a contrary development, the Washington Government shall go forward with the project with such governments as are agreeable.

The President would like to see both land and naval armaments brought within the scope of the conference, but as to neither phase will the American policy be other than one of moral appeal, in no way marked by coercion.

A Manufacturer on Preparedness

From an address by Gary E. Tripp, Chairman, Westinghouse Electric and Manufacturing Company. And that brings me back to the significance of this meeting. It is one of the proofs that our increasing intelligence has kept pace with our increasing honesty. We are marching toward that type of citizenship which concerns itself with other things besides their personal affairs. If this were not so, each of you would have purchased his pound of beefsteak at the butcher's and been on his way to dinner by this time.

One of the great things which the American people are coming to see is that it is just as prudent to be prepared for defence as it is to be prepared for peace and that the one is just as much of a job for each citizen as the other. They know better than their ancestors did that in order to remain great and prosperous the nation must also be strong enough to defend its

political rights and territory. I say the people know this because such men as you are showing an interest in the plans for perparedness, which have been prepared by our capable and far-seeing army and naval officers.

I have confidence that these plans are the best that can be devised for establishing our country on a feasible preparedness basis with the least possible expense; because, first, they speak for themselves; and, next, our army and navy personnel has increased in intelligence to the same degree that the intelligence of the people has increased.

Compare, if you will, the selective draft system adopted in the recent war which was conceived by an army officer, General Crowder, to the ill-conceived methods used during the Civil War, resulting in the draft riots of 1860, and the brisk traffic of that time in substitutes.

Note the difference between the Plattsburg system for making officers out of civilians inaugurated by General Wood and the self-appointed officers who raised companies of their own in various parts of the United States in 1860.

And, lastly, observe the complete success of General Pershing, the first and only United States Commander-in-Chief in the Great War, who demonstrated his fitness in so many ways and especially by his inflexible determination that the American troops should fight under their own flag and not be dispersed along the front to make good the waste in the allied armies, with the result that, when the opportunity came, the American troops were a unit, splendidly trained, and made the first and only break through the German lines and ended the war. Compare the steady support of General Pershing with the numerous changes in our commanding officers and the disasters which ended these changes in the Civil conflict, and you must conclude that the military intelligence of our army and navy organizations has greatly improved in sixty years.

This type then is the type of military organization which has devised the plan of maintaining a Reserve Officers Training Corps, not only in order to retain the experienced young officers who served in the late war, but also supplement them with intelligent young men from civic life who likewise be given a military training to the end that there will always be in this country a skeleton organization of officers capable of commanding armies in case of war.

But army men know that officers and men are not enough—they must be equipped; and, therefore, not the least important of their plans is that feature which involves industrial preparedness. It has been demonstrated to the satisfaction of even those ardent souls who believe that a million men can spring to arms over night, and that if they do so there would be no arms to spring to, and that it requires time and preparation to adequately equip an army with the most modern instruments of war; and, further, that without such an equipment, an army which arrays itself against one so equipped simply commits suicide. It is in support of this particular part of the defense plans that the cooperation of you gentlemen is asked.

It is not only patriotic for American industry to cooperate wholeheartedly with the War Department in its plans for Industrial Defense, but it is one of the most practical things it can do.

War lays a heavy hand on industry. It consumes its equipment, disorganizes its labor, upsets normal business methods, causes unhealthy and dangerous expansions, exhausts the energies of management, and in many other ways injures and destroys.

It is an unmitigated evil. There is not a stable industry in the country today that was actually benefited by the last war, in spite of immense sales and in many cases enormous prices.

We cannot hope, of course, to eliminate completely these destructive effects of war.

War is never welcomed by a nation like our own; but, if it comes, industry must bear its share of the burdens. But at least we can try to reduce these burdens to the lowest possible minimum; and, if we succeed, not only industry but the nation at large will gain greatly thereby.

The industrial defense plans of the War Department are the direct result of our recent unpleasant experiences and form by far the most promising solution to the problem of rapid industrial mobilization that has yet been put forward.

They give to each manufacturer specific information as to what he will be expected to do in an emergency and permit him to work out at his leisure the most effective way of doing it.

In a word, they make possible the doing of good work for the nation under the best possible conditions instead of forcing the turning out of bad work under the worst possible conditions.

Especially they eliminate as far as such a thing can be done, the fly-by-night manufacturer, who upset markets, cornered supplies, pre-empted labor, clogged transportation, did poor work, and was the real profiteer during the late war.

With these plans fully developed, American Industry will be master of its own situation and, if put to the test will go at its work calmly but rapidly and without hysteria or visions of sudden wealth.

Four or five more years of this kind of experimentation will probably be needed before we can be satisfied that all is shipshape. Therefore, we shall only have to keep the machinery well oiled and provide for new developments.

I wish it were true that unpreparedness was a guarantee of peace. That would be an easy and simple way to stop wars. But in all history there is not a case where a nation was ever saved from attack by its weakness. We ourselves have given the theory of unpreparedness the most thorough trials; we have never been prepared for war, and yet we have had at least two wars in every generation since the founding of the Republic.

I agree that huge armaments, especially when they are under the control of an irresponsible autocrat, constitute a menace to the peace of the world, because he, having the power and the ability, is likely to try his hand. It is the fear of something of this sort that inspires the pacifist in his endeavors to obstruct all undertakings of a military character. But, as far as we are concerned, the fears of the pacifist are groundless for two reasons: In the first place, there is no autocratic power in the United States; and, secondly, our preparedness plans are directly opposed to the piling up of armaments. What is advocated, on the contrary, is the maintenance of a skeleton organization of volunteer reserve officers without pay, who live their civil life exactly as they would if they were not officers, and the plan for the rapid production of war material. But this industrial preparedness plan is one which, if put into operation, will have so profound an effect on the daily lives of every one that no one would have the temerity to start it except under circumstances of the gravest national danger.

These plans do not constitute a challenge to any foreign nation. The only possible reply that even the most aggressive of our neighbors can make to it is to initiate similar systems themselves. To this we would not have the slightest objection; we could see in it no danger to ourselves and would freely concede that it was not only their right but their duty to take such effective defensive measures.

Hence we have nothing to lose and everything to gain by cooperating wholeheartedly in these plans. American industry, I feel sure, holds these views, and I venture to guarantee here that it will make every proper effort to bring these vitally important plans to perfection.

MERCHANT MARINE

The Need for Revision of Our Navigation Laws

By Alfred Gilbert Smith, President, The American Steamship Owners' Association; *The Nautical Gazette*, 14 March, 1925.—Broadly speaking the navigation laws of the United States may be divided into three main parts or divisions: one dealing with registration and enrollment of vessels, measurement, documentation, mortgages, etc.; one dealing with the personnel of vessels, licenses, manning, engagements, discharges, etc.; and the third one dealing with the provisions directly related to the vessels themselves, their materials, their equipment and their inspection.

While much has been done by the administration—in fact, all that it can consistently do—for the convenience of government officers, owners, masters, seamen, etc., to present the laws and the rules and regulations thereunder in convenient form, the fact remains that our navigation laws (due to the many amendments that from time to time have been made) require untold study and research for a clear understanding of their scope, purpose and effect.

I believe that there is much in the navigation laws of our country that is sound, absolutely necessary for the protection of life and property, and fair alike to owners and crews of vessels, to say nothing of passengers and all other interests involved. Unfortunately, there are a great many unnecessary, obsolete provisions and there are, too, a number that in my judgment are unsound. To broadly denounce the navigation laws as being solely responsible for the slow development or directly retarding the expansion of our shipping industry is, I believe, grossly unjust. Many provisions are—particularly in the Seamen's Act—questionable; others decidedly antagonistic to the healthy growth of our merchant marine. And there is absolutely no question that existing statutes, having for their foundation laws that were enacted and promulgated many years ago, should be revised and properly recodified.

From the standpoints of safety of life and property at sea, not only the steamship owners (who are directly concerned), but the men who travel in ships, shippers, underwriters—in a word, all who are in a greater or lesser degree interested—are entitled to have some voice in the revision of the laws that govern navigation.

In many respects we are sadly behind our chief maritime competitor, Great Britain. Their Shipping Act of 1894—which is the consolidation of all the Merchant Shipping Acts from 1854 to 1892, put in concise form for ready and convenient reference—is a model that our country might well seek to follow. Indeed, it has been said by many shipping authorities that no better thing could be done by us than to take boldly the Shipping Act of Great Britain and, making such changes in phraseology as are necessary to adjust it to our form of government, adopt it as the maritime law of the United States. Such a procedure would well serve our purpose, for I confess there is a great deal of sound logic in this proposition, if certain prejudices could be removed.

The strict interpretation of our navigation laws—which, generally speaking, are of a mandatory character—has led to many serious and troublesome causes of litigation between owners and government officials. It is difficult, if not impossible, to comply rigidly with the laws when frequently the rules of one department conflict with the rules of another department of the same government.

Now, what are the provisions in our navigation laws particularly objected to by the shipowners? Let me enumerate a few that have received special study, have been made the subject of review, and upon which recommendations have been made by a committee of representative men—

already alluded to—appointed by Chairman Payne of the Shipping Board in June, 1920. But, let me point out as a preliminary, the provision of a law passed in 1916 which requires the Shipping Board to examine the navigation laws of the United States and the rules and regulations thereunder, and make some recommendations to Congress as it deems proper for the amendment, improvement and revision of the said laws. While, I believe that much work has been carried on by direction of the Shipping Board and under its direct supervision, no recommendations—that I am aware of— have yet been made by the Shipping Board, although more than eight years have elapsed since the Act that contained this provision was passed.

Let us take Tonnage Measurement upon which our regulations are substantially those that govern in all the principal maritime nations. Prior to 1915 certain exceptions were not allowed under our rules, but these exceptions have been removed. The fact is that with the limited number of vessels in foreign trade in the past, the factor of tonnage did not enter materially into the operating cost calculations of the owners. Owners and builders are now taking advantage of the opportunity offered by our rules, by remeasuring their vessels, and, therefore, there is no cause for complaint as to any disability to the American ship on this point. The admeasurers, however, should be transferred from the Treasury Department to the Department of Commerce, where they rightfully belong.

Differences of opinion still prevail among a number of American owners with respect to a fixed load line chiefly because, in my judgment, there is some misunderstanding as to its scope. It is feared that it might be an unnecessary hardship in certain trades. Peronnally, I believe that the adoption of fixed load lines under suitable legislation would be, in the long run, most advantageous. The Commissioner of Navigation has repeatedly recommended it and I hope that—following the example of Great Britain and other maritime nations—a load-line law will eventually be passed that will insure safety and at the same time will permit practical operations of our ships. Legislation on this should be subject to uniform international agreement.

As to hydrostatic tests, the recommendations made seem to be well supported by practical demonstrations. They are substantially these: That the test may be made at the initial inspection of the boilers, and thereafter at the survey periods in the case of vessels classified by recognized societies if the surveyors deem it necessary, and in the case of vessels not so classed at periods not to exceed three years. I think a graphic description of the manner of conducting the test under our rules and possible effects is that given by the individual who, in substance, said: "It is like giving a man a vigorous kick in the stomach to ascertain whether or not his digestive apparatus is in good condition. If he survives, then you have proven conclusively that he is in good physical condition and that that part of his anatomy is functioning properly; but if—as the results of the test—he is partly injured or irretrieveably damaged, how can such injury or dammage be remedied or compensated?" Such is the case with boilers that are periodically and excessively subjected to the hydrostatic pressure test—which I am told by those who profess to know—tends to weaken them without, in the last analysis, necessarily affording the desired protection.

If fusible plugs furnish—as doubtless they do—an additional safeguard, no objection should be made to them, even if their installation and inspection are causes of inconvenience. The complaint is not with the device itself, or its cost, but with the changes in the rules which in the past have been numerous and perplexing—and these remarks apply with equal force to many other fittings in the equipment of vessels.

A word now about repairs at foreign ports. The heavy and unjust burden that rests upon American shipowners operating foreign-trade ships, namely, the fifty per cent tax upon repairs made abroad, should be removed. It is not a provision of the navigation laws, but of the Tarriff Act of 1922, and it is a pernicious provision. If American ships obtaining any aid against foreign competition, then such of us who believe in proctive tariff might be silenced, if we would be consistent, against the demands of the shipyards of our country. But we have no such protection, and the owners believe that there is no justification for continuing this tax. It is my earnest belief that the repair yards of our country will come forward and offer to make restitution by having this law repealed. Every burden that lessens the chance of American ships holding their places in the trade and increases the number of foreign ships in American trade, reduces the source and quantity of possible repairs in American yards.

As to enrollment of vessels: The requirements of the law are subject to so much detail that a single document has been recommended to designate the trade in which a vessel may be engaged. While it may be said that this is not a serious question, the fact remains that— added to many of like character—the owners, and incidentally government officials, are subjected to much unnecessary labor. Economy in time and effort is as important as economy in money. They spell the same result.

Let me briefly touch on the question of home ports and ships' mortgages. Under the interpretation given by the court in a recent case, a feeling of uncertainty has arisen in regard to maritime securities relating to mortgaged vessels. The law has now been amended, and it is understood that it will be further revised and elaborated in order to legally designate the vessel's home port and to validate—in proper cases, of course—mortgages, liens, etc., that rest upon vessels.

As to personnel: The law places the manning of vessels in the hands of the local inspectors, where it doubtless belongs. In practice it happens that, while the inspectors in one port fix a certain number to constitute a crew, the inspectors in another port may require an additional number on the same ship. There should be a certain control to authoritatively determine this and many similar questions.

In the matter of licenses for officers, it is believed that these should be of a permanent character, subject only to the five-year sight and hearing tests. And it is likewise recommended that when officers are brought to trial for negligence or any violation of the law they should have the right of appearing with counsel and a proper right of appeal. The local inspectors, under existing procedure, are not only prosecutors but judges, and the men are denied opportunity of defense that is accorded to every citizen in our courts.

As the early enactment of our laws indicates, our legislators of old had in mind the inland steam vessel. Legislation that bear no discretionary authority and which covers so many types of vessels today makes difficult its application. It has, therefore, been recommended that vessels be classified into steam and motor, having regard to types and trades, such laws and rules to apply to such types and trades, with discretionary authority in their application, without, however, sacrificing safety.

Contrary to the general belief, the repeal of the Seamen's Act would not place our ships on an equality with foreign vessels. Our vessels were at that disadvantage long before the Seamen's Act was enacted. What the Act really does is to place added burden upon the American ship, which the foreign ship escapes. Insofar as life-saving equipment is concerned, the Act substantially embodies the regulations of the International Conference on Safety of Life at Sea. Among the things mainly objected to is

the fact that it clearly encourages desertion. This is freely admitted by the promoters of the bill. It would seem as if we had one set of our laws conflicting with another set—the Seamen's Act encouraging the desertion of aliens, the Immigration Act restricting their landing on our shores.

Let me say right here that to punish the foreign owner for the benefit of the American owner, or to promote the cause of the American owner at the expense of the foreign owner, by base methods and devious ways is—to say the least—unfair and contrary to what I believe to be American principles. Let us fight our foreign competition, but let us fight on terms of fairness. Let us compete in character of service, not by taking unfair advantage of those who have equal rights to the use of the ocean, or by encouraging the men whom they employ to break the laws of their own country.

What does the payment, in part, of wages of American ship seamen at outports mean under the Seamen's Act? That men are entitled to their pay, no one will question. But who takes advantage of the law? Is it the man who is thrifty, of steady habits, worthy and ambitious to legitimately better himself? No. It is he, who, forgetting his obligations and taking undue advantage of the right that a law ulteriorly designed affords, spends his wages foolishly, perhaps gambling and in dissipation.

Whether the law gives the men the right to demand their wages or part of them, the money earned is there in the hands of the master or the agent. But in practice is it wise always to give it? Is it always necessary? Is it expedient in the promotion of discipline and order to place temptation in the hands of the men at outports? If you want an answer, read the consular reports in thousands of officially recorded cases, and see what the universal verdict is. Observe how many men—after having squandered part of their earned wages in reckless, often in riotous dissipation—return to their ships unfit physically and morally to perform their duties, not alone to their own detriment, but unfortunately also to that of sober-minded shipmates who are thus obliged to "double-up" on their work and to assume the labors of the worthless spendthrifts. This does not spell for safety of our ships or for the safeguarding of lives and property in the case of disaster by "skilled seamen."

Take the cases of the number of distitute seamen who must be cared for by consular officers the world over because of the opportunities that are accorded them to squander their wages and become charges on our country's treasury.

Under no other flag do the people of all classes— whether on land or sea—enjoy the liberty that we enjoy; under no other flag has a man—whether ashore or on the water—the opportunities that he has in America or on ships flying the Stars and Stripes. The danger, as I perceive it, is that —carried away, mentally or morally intoxicated (so to speak) with the great liberties that are enjoyed—some seek still more and greater ones, forgetting what we owe our neighbors, what we owe to ourselves; and that liberty is not license, "opportunity" does not mean abuse, reason is not a synonym for "madness."

We have too many sea lawyers, most of them ashore. It is monstrous on the part of certain public agitators and self-styled promoters of life safety to charge law-abiding men—men of integrity, men of intellectual honesty, men of humanitarian instincts—to charge them, I say, with purposely, indifferently, criminally exposing to danger thousands of lives by permitting them or forcing them to travel on vessels that are unseaworthy or insufficiently equipped or manned. Can you conceive of reputable men, engaged in an honorable and important industry, descending to such depths of depravity? Is it just to charge the shipowning industry

with criminality because an occasional rascal breaks—or attempts to break—the law by whitewashing a rotten hulk or camouflaging her equipment?

It is my belief—and I am proud to broadly proclaim it—that many shipowners should take a greater interest than they appear to have manifested in the past in their relations with the officers and men who man their particular ships. A closer human interest should be built up which will have for its ultimate object closer and more intimate cooperation with the men. The result will be increased efficiency on the part of the men and, in the long run, profit to the employers. But—it may be asked—how are you going to accomplish this? I confess that the task is not as easy as it appears on the surface. As a matter of fact, it is pretty difficult to agree upon, formulate and put into effective operation a plan to which everyone—whether employer or employe—may subscribe. But it is not altogether impossible, provided that there is good faith on the part of all and that suspicion ceases to abide in the minds of those interested. Can this be, in the light of the many and repeated violations of contractual obligations and the unfair advantages that have been taken by miguided men in many branches of the shipping industry? Without good faith, without absolute trust in each other, without intellectual honesty in working out a plan and abiding by it, no understanding that will be satisfactory and profitable to both employer and employe can be possibly brought about.

Is it not a fact—well attested by past experiences—that many men, upon securing berths on ships, begin their jobs by inquiring, "What are our rights?" "What are our privileges?" How much better if these questions were, "What are our duties?" "What are our responsibilities?" "In what way can we make ourselves worthy of confidence and trust by our employers in order that, in giving them reasonable service and striving to attain higher standards of efficiency and usefulness, we may merit support and advancement to better positions, to reach higher ranks of greater responsibility and honor?"

The primary thing for safety at sea, in my judgment, is to have as nearly as possible safe ships; in other words, ships that are well constructed, well subdivided, with substantial engines, realiable boilers and adequate auxiliaries.

I repeat, too much stress has been laid on the skill of the seamen and too much attention directed to life-saving equipment. Not for a moment do I intend to convey that this equipment should not be complete, adequate and reliable in every respect because of certain contingencies and risks that sea travel entails. But the point I want to make is this: The folly, for example, of constructing a flimsy house of inflammable material and then equipping it with substantial fire escapes and life-saving devices and providing it with a full corps of firemen. How much wiser to construct a strong, substantial, fireproof building to begin with? In short, "safety first."

Remarkable Development of Foreign Trade of the Philippines

The Nautical Gazette, 7 March, 1923.—The remarkable development of the Philippines along shipping and industrial lines is shown by the fact that two generations ago the islands were practically unknown commercially in the trade centers of the world. Today they are a very real factor in the world trade, the foreign commerce of the islands having grown from a valuation of only 10,000,000 pesos in 1855 to nearly 500,000,000 pesos in 1923.

The earliest available records of foreign commerce of the Philippines begin with the year 1855. In that year the total value of all imports and exports was 10,000,000 pesos. In the year 1895 (the last year of Spanish

sovereignty for which records are available) the value of foreign trade had grown to 62,000,000 pesos. The growth of commerce appears to have been quite gradual and the balance of trade was generally in favor of the islands.

During the period of American sovereignty over the Philippine Islands, 1890 to 1923, the growth of the import and export commerce of the islands has been phenomenal. From a total value of foreign commerce of 68,000,000 pesos in 1899, the value has grown to 417,000,000 pesos in 1923. Even this total value was exceeded during the favorable years of 1918, 1919 and 1920. During the first six years of this period the balance of trade was against the islands, but during the following years the balance of trade was generally favorable, so that the net balance in favor of the islands during the entire period amounted to 178,000,000 pesos.

The Port of Manila, which is the chief port of the Philippines, is centrally situated with reference to the great markets of the Orient, at the head of Manila Bay approximately thirty miles from its entrance and at the mouth of the Pasig River.

The south harbor, consisting of 1,250 acres of anchorage, is protected by 10,000 feet of rock breakwater wall. Vessels anchoring within this area may load and discharge cargo throughout the entire monsoon season without difficulty and, except for short periods of heavy weather during the passage of a storm, can be safely worked throughout the year.

Pilotage at the Port of Manila is optional with the master of the vessel within the harbor. It is compulsory in the Pasig River for vessels over sixty tons gross. Only coastwise vessels enter the river.

The average depth of water within the approved anchorage area is thirty feet zero tide. This depth is maintained by regularly dredging to thirty-two feet. Preparations are under way for dredging the entire harbor to forty feet.

Approximately 7,000 feet of berthing space is available at the piers and wharves—sufficient to permit the berthing of nine or ten large transpacific vessels simultaneously.

The Port of Manila has four government-owned piers and bulkhead wharfage available for the accommodation of the overseas trade with sufficient berthage for nine or ten large transpacific vessels.

There are also excellent facilities for fueling, drydocking and repairing vessels.

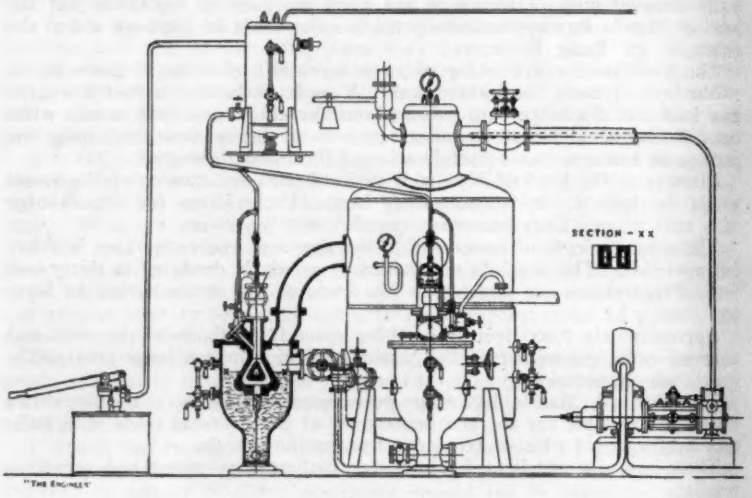
One of the greatest improvements to the shipping facilities of Manila Harbor will be Pier 7, which, when completed, will be comparable to the largest and finest equipped piers in the world. This pier will be 1,400 feet in length, 240 feet wide, and covered by a transit shed 1,253 feet by 160 feet. It has a depth of water, at zero tide, of thirty-five feet, which enables it to handle with ease the largest type of transpacific liners. Construction work on the pier was started some four years ago and it is now eighty-two per cent completed with the final date of completion in view seven or eight months hence.

Hemp and sugar lead the list of export commodities of the Philippines, the value of sugar exported during the year 1923 amounting to 69,000,000 pesos and the value of the hemp exported totaling 50,000,000 pesos during the same period. The Phillipines are practically the only place in the world where hemp can be successfully grown and the islands have practically a monopoly of the growing of this, the best vegetable fibre known for the manufacture of high-grade cordage. As may be expected, manufacture of rope is an important industry in the Philippines, and among the concerns engaged in this business the well-known Johnson-Pickett Rope Company holds a leading position.

ENGINEERING

New Belgian Boiler

The Engineer.—The Internal Combustion Boiler. All designs of boilers are based on the principle of bringing the flame of the fuel into the closest possible contact with the water in the boiler. If this is one of the main ideas why not burn the flame inside the water? Is it possible to burn a flame in immediate contact with a liquid? It is, as every kind of liquid fuel burns in the liquid as long as the quantity of air or oxygen is large enough to ensure complete combustion. This idea is fully demonstrated in the working of the internal-combustion boiler, the principle of which is to maintain a flame burning in the liquid in order to evaporate the latter. During the years of experimenting, liquid hydrocarbons of a specific gravity between .8 and 1.2 have been used. Tar oil from Belgium, coal tar from Germany,



BRUNLER SUBMERGED-FLAME BOILER

Astatki from Baku, waste oil from America, and different kinds of oil from every part of the world have been tried. More than sixty different kinds of oil have been tried, and all could be burnt without difficulty.

The fuel crude oil, etc., and the air which is necessary for the combustion are supplied to the burner under a pressure which barely exceeds the pressure of the steam. The temperature in the center of the flame is approximately 1,800° C. This temperature diminishes to the periphery of the flame, so that between the center of the flame and the periphery a rapid fall of temperature takes place. Since a permanent stream of burning gas has to pass this fall of temperature, it is evident that also the last traces of carbon-monoxide must be converted into carbonic acid. In leading the combustion in such a way the possibility is ensured of burning the fuel more completely than in the open air. The combustion under pressure brings the molecules of the fuel into better contact with the oxygen, therefore under pressure and in water the most complete combustion can be obtained.

The mixture of gases which pass from the steam generator to the steam reservoir contains sixty per cent of steam, and forty per cent of gases.

These are the same gases which work in gas and oil engines, the only difference being that in such engines the amount of steam is much less.

The presence of this great quantity of gas in the steam makes the condensing engine impossible; i. e., the exhaust steam can be condensed, and as feed water be pumped into the boiler, but a vacuum cannot be used because vacuum pumps of a very large size would be required. But this fact is not a serious disadvantage. The main idea is to save as much fuel as possible, and to obtain the highest efficiency. If this is possible without condensation all the better. Instead of the condenser we have an air compressor, which takes less space and needs less repairs than the condensation plant.

Practically every engineer and scientist maintains that the determination of the calorific value of any fuel, whether liquid, solid or gaseous, is exact, if we determine it either in the bomb, or calculate it by means of the chemical analysis. However, when we have to deal with the combustion of fuels or explosives we have sometimes to face riddles for which we have no explanation, since they are absolutely opposed to our knowledge regarding the heat theory and to the energy produced by the combustion according to our established formulas. I am of the opinion that under certain conditions which are still unknown to us electric vibrations produced during the combustion are converted into useful energy and thus a higher efficiency than 100 per cent is obtained. In such cases we have to add an unknown energy X to our formulas. This factor X may represent the energy of the electric vibrations during the combustion.

During the tests which have been carried out with the submerged flame evaporations have been obtained which surpassed the theoretical ones. Samples of the oil which were used during the tests were chemically analyzed and burnt in the calorimeter and the exact calorific value of the oil was determined, but for weeks and weeks a higher calorilc value and consequently a higher efficiency than 100 per cent was obtained.

The annexed figure shows a typical Brunler submerged flame boiler. In this case two or three steam generators are attached to one steam reservoir. A burner is placed vertically in the center of each generator, and the flame is directed downwards. The ignition of the flame is effected through the inclined passage on the left of the burner. The burner is rectangular in cross section, and a water passage passes through its center.

Double Acting Diesel Engines for Transatlantic Passenger Liner

The Shipbuilder, March, 1925.—From the engineering standpoint, the most interesting ship at present in course of construction is the twin-screw motor-driven passenger and cargo ship *Gripsholm*, which was launched by Sir W. G. Armstrong, Whitworth and Co., Limited, from their Armstrong Yard on November 26 last, and which is now being completed afloat on the Tyne. This important vessel is being built to the order of the Swedish-American Line, of Gothenburg, and is intended for their direct service between Sweden and North America. Her leading particulars were published in this journal on the occasion of her launch, but they may be recapitulated here as follows:

Length overall	574 ft. 6 in.
Length B. P.	550 ft. 0 in.
Breadth extreme	74 ft. 3 in.
Breadth moulded	74 ft. 0 in.
Depth moulded to boat deck	76 ft. 6 in.
Depth moulded to *D* deck	42 ft. 6 in.
Load draught	29 ft. 0 in.

Load displacement, tons	23,600
Deadweight, tons	10,000
Gross tonnage, about	17,000
Speed on service	17¼ knots
Oil-fuel capacity, tons	2,450
Passengers:	
First-class	112
Second-class	482
Third-class	1,006
Crew	320
Total	1,920

Chief interest, however, centers in the type of propelling machinery which is being installed in the *Gripsholm*. She will be the first ship in the world to be equipped with Burmeister and Wain four-stroke cycle, double-acting, reversible Diesel engines, and she will be the first motor-driven mail and passenger ship to be employed in the North Atlantic service. The complete machinery is being supplied from Messrs. Burmeister and Wain's engine works in Copenhagen, and consists of two six-cylinder main Diesel engines developing a total of 16,300 I.H.P. at 125 r.p.m. under ordinary working conditions at sea. Each cylinder has a diameter of 840 mm., with a stroke of 1,500 mm.

The necessary compressed air is taken from three separate 800-I.H.P. Diesel compressors, each being capable of supplying the compressed air required by one of the main engines, and accordingly when at sea it will only be necessary to run two of the compressors, the third acting as reserve. Special means have been adopted to fully balance the compressor engines as well as the main machinery, so as to avoid hull vibration. These compressors also supply the necessary air for maneuvering.

In addition, there are installed three Diesel generators each having a capacity of 330 kw., so that a total of 990 kw. will be available for supplying electric current for operating the auxiliary machinery and for lighting, fans, wireless, etc. These generators are also fully balanced in order to avoid vibration.

The total power developed by both the main and auxiliary engines will be 20,650 I.H.P.

It may be recalled that the contract for this machinery is the outcome of the results obtained from experimental work, extending over a period of more than two years, by Messrs. Burmeister & Wain on a single-cylinder double-acting engine developing 1,000 B.H.P. This experimental engine was the subject of an illustrated article in No. 154, Vol. XXVIII, of *The Shipbuilder*.

The first of the main engines for the *Gripsholm* has now undergone successful shop trials, and during a 48-hour test the following results were obtained:

Number of revolutions	124·6
Brake horse power	6,858
Indicated horse power	8,655
Mechanical efficiency, per cent	79·24
Fuel-oil consumption, average, per hour, kg	1,189
Average fuel-oil consumption per I.H.P.-hour, grammes	137·3 (·302lb)
Average fuel-oil consumption per B.H.P.-hour, grammes	173·3 (·381lb)

The Future of the Motorship

The Shipbuilder, March, 1925.—For his presidential address, delivered before the Institute of Marine Engineers on the 10th February, Sir Westcott S. Abell, K.B.E., took as his subject "The Motorship in the Light of the History of Marine Propulsion." As evidence of the increasing adoption of motorships, he quoted the figures given in the Annual Report of Lloyd's Register of Shipping for 1923-24, which show that the tonnage of motorships of over 100 tons gross has increased from about 750,000 tons gross in July, 1919, to nearly 2,000,000 tons gross five years later.

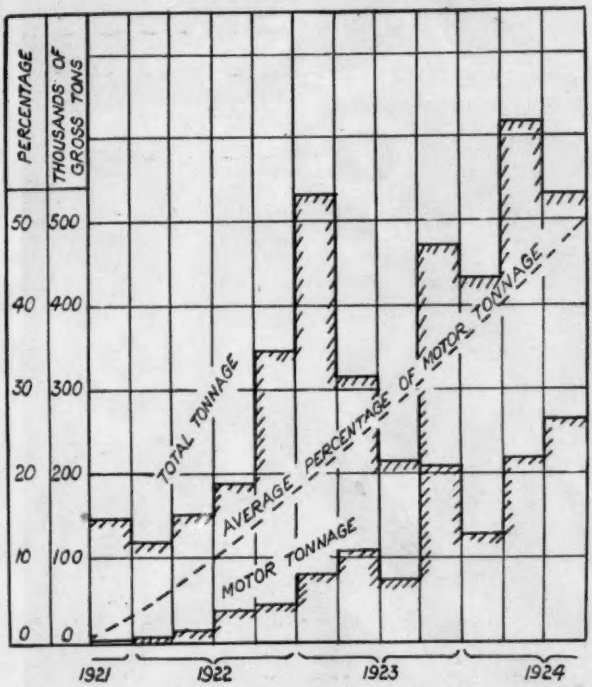
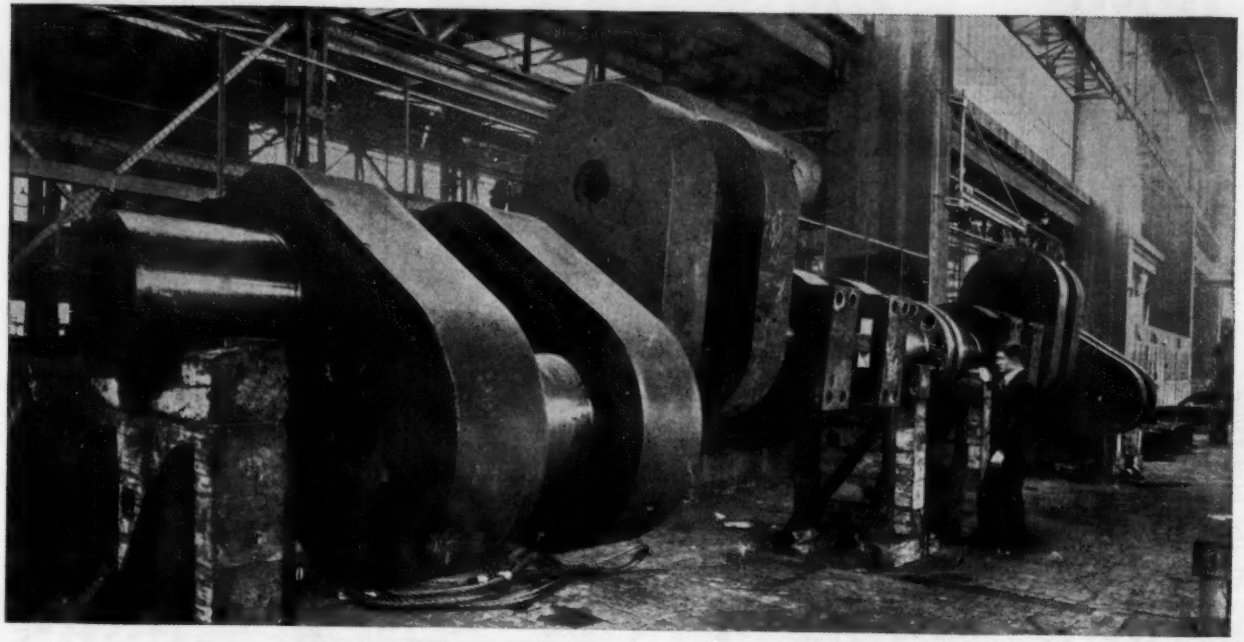


FIG. 1.—MERCHANT SHIP CONSTRUCTION COMMENCED IN THE WORLD DURING EACH QUARTER

More interesting still is the tonnage of motorships under construction in relation to the total tonnage of vessels being built. Fig. 1, taken from Sir Westcott Abell's paper, shows the gross tonnage of steam and motorship construction commenced in the world during each quarter from December, 1921, to date, as well as the percentage of that total tonnage intended to be driven by motors. Whereas the amount of motor tonnage was insignificant in January, 1922, the demand has steadily risen, until by September, 1924, somewhere about 50 per cent of all self-propelled vessels commenced are motor-driven.

Even with such progress, Sir Westcott Abell points out that the time taken by the introduction of the motorship must be relatively long, for at



One of the Crankshafts for the "Gripsholm." Diameter 550 mm., Weight 67 Tons.

present there are nearly 62 million tons gross of steam and motor tonnage in existence, the motor tonnage only accounting for the odd two millions.

Such facts as these, however, he concluded, do indicate that the experience gained in marine transportation with Diesel-engined ships during the last fourteen years has been such as to satisfy the requirements of reliability on service, and that the disappearance of the steam engine from overseas trade is largely a matter of time.

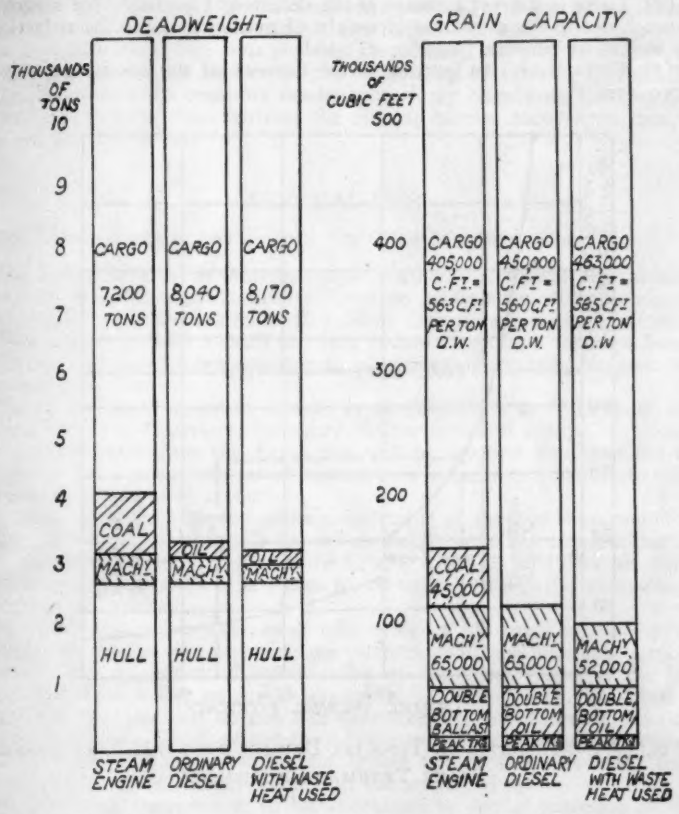


FIG. 2.—COMPARISON OF DEADWEIGHT AND GRAIN CAPACITY OF STEAM AND OIL-ENGINED SHIPS

In confirmation of this view, he mentioned that Lloyd's Register of Shipping, which has been so closely interested in this deevlopment, have recently decided that, instead of requiring an annual survey of motorships, they will be satisfied with a special survey every four years, with a modified examination at each intervening period of two years.

Having examined the position as to the reliability factor of the present Diesel engine, it remained to investigate the economic aspect. *The ship being the same*, a comparison between motor-engined and steam-driven vessels indicates that:—

ONE OF THE CRANKSHAFTS FOR THE "GRIPSHOLM." DIAMETER 550 MM., WEIGHT 67 TONS.

(*a*) There is an increased first cost—involving increased interest and depreciation;

(*b*) The wage cost per ship tends to be less, while the cost of handling oil on the ship is also much below that required for coal;

(*c*) There is a greatly reduced consumption of fuel—which fuel, although costly, yet costs less in the aggregate than coal;

(*d*) There is an increased cost for lubricating oil;

(*e*) There is a great increase in the deadweight available for cargo—not so much due to the alteration in weight of machinery as to the reduction in the weight of bunkers (see Fig. 2); and

(*f*) There is also an increase in the capacity of the spaces available for cargo (see Fig. 2).

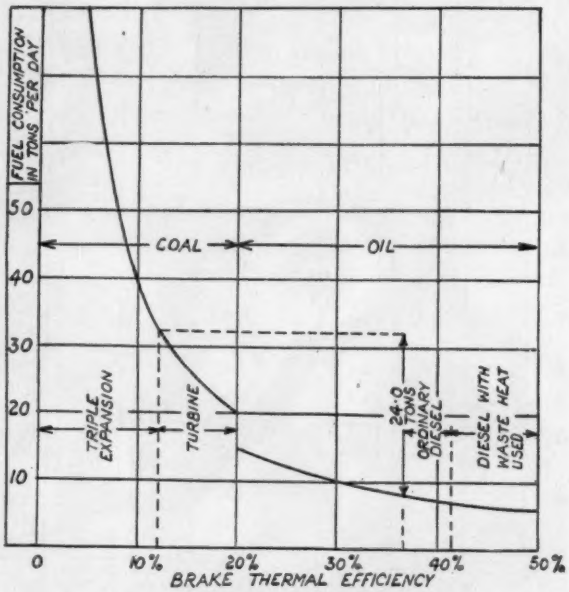


FIG. 3.—CONSUMPTION IN TONS PER DAY FOR 2,000 B.H.P. AT VARIOUS BRAKE THERMAL EFFICIENCIES

All these factors have to be considered, weighed and summed up from the cost per ton-mile; and in considering the position today, sufficient experience seems to have been obtained to make it clear that with the present availability and cost of oil fuel there is a distinct margin of prifit in favor of the Diesel-engined ship compared with the coal-fired boiler and steam-engined vessel.

The great factor in the economic efficiency of the motorship is the large reduction in fuel consumption due to the higher thermal efficiency of the Diesel engine compared with the steam engine.

Fig. 3 shows the relation of fuel consumption to the thermal efficiency *per brake horse-power* for coal and steam engine—and for the oil engine—in tons per day for 2,000 brake horse-power. The limit of the ordinary

steam engine with coal is shown as 13 per cent, for the steam turbine and coal as 20 per cent, for the steam turbine and coal as 20 per cent, for the ordinary Diesel as 37 to 41 per cent, and for the Diesel with recovery of exhaust heat as 47 per cent. The form of the curve indicates that further progress in economy can only be obtained slowly, and also probably at the expense of simplicity. Certainly the main saving, as far as the design of the ordinary merchant ship is concerned, is that with the Diesel oil engine there is a fuel saving of twenty-four tons per day or more in comparison with the coal-burning steam engine, the figures for the two types being eight tons and thirty-two tons per day respectively.

Allowing an average bunker weight for trading of 1,000 tons, which has to be taken out of the available deadweight of say 8,000 tons, the coal ship can only carry 7,000 tons, whereas the oil ship carries about 7,750 tons, or over ten per cent more.

AERONAUTICS

Navy Plans Nearly 300 Planes for Five Aircraft Carriers

The Baltimore Sun, 21 March, 1925.—Washington, March 20.—Launching of the monster aircraft carrier *Saratoga* at Camden, New Jersey, on April 7 will mark the initiation of a Navy Department program to equip the fleet ultimately with a swift air wing composed of more than 150 bombing planes and their proper complement of combat, observation, torpedo and other auxiliary aircraft.

The air flotilla, designed to operate as an offensive arm of the fleet, will be composed of five carriers, Secretary Wilbur disclosed today. The *Saratoga* and her sister ship, the *Lexington,* will be the first pair, and the remainder of the treaty allotment of 135,000 tons in carriers will go into three 23,000-tonners, yet to be authorized.

Roughly estimated, the full plane complement of the five ships would be close to 300. Their aircraft will be exclusive of those to be carried on battleships and other surface or subsurface fighting craft or whatever air force might be assigned to ships of less than 10,000 tons, on which the treaty places no limit as to number.

Mr. Wilbur is not in agreement with some of his naval advisers as to when the building of the new airplane carriers should be undertaken. The General Board recommended authorization of one 23,000-tonner at the last session of Congress, but no action was taken. The Secretary is inclined to believe that final decision on size and characteristics should await practical experience with the *Saratoga* and the *Lexington,* which is to be launched at the Fore River Works, Massachusetts, within two or three months. Both are expected to be in commission during the winter of 1926.

The two ships, converted from battle cruisers by special provision of the armaments limitation treaty, will be the largest and fastest ships of the type afloat. They displace 35,000 tons as compared to the treaty limit on future carriers of 27,500 tons.

The original plans for the *Saratoga* called for a heavily armed and armored fighting ship to make about thirty-five knots an hour, but with the change in mission to that of aircraft carrier the *Saratoga* had to be redesigned and rebuilt from the water line up.

As redesigned, the *Saratoga* will be 888 feet long over all, with a maximum beam of 105 feet. She will carry eight 8-inch rifles, the limit of size for ships of her type under the treaty, and will have a speed of between thirty-three and thirty-four knots. She will be driven by electric motors, the power being generated by steam turbines of 180,000 horsepower.

There is no counterpart for this first American first-line carrier in any other navy, although Japan has under construction similar ships of almost as great size, but considerably lower speed.

The British are building three new carriers within treaty limitations and are experimenting also, it is said, with a carrier of less than 10,000 tons. The American second-line carrier *Langley,* Mr. Wilbur said today, will be used to test possibilities of the less-than-10,000-ton unlimited type, although she is too slow to be fully effective.

Both the *Saratoga* and *Lexington* are the "Island" type, with smokestacks set at one side to free from the danger of gas fumes aircraft landing on the deck.

The British have tried out a "flush-deck" type of carrier with no smokestacks, but with the gas from the furnaces piped astern and driven out with blowers. Even with that type, however, the great blast of hot gases has caused difficulty to the flyers by making the air "bumpy" and planes hard to control at the critical moment of an attempted deck landing. Until the *Saratoga* is in operation no definite decision as to the best type for future carriers will be reached.

Airplane Carriers

Washington Post.—The cost of the two airplane carriers now under construction for the United States Navy has been increased to a limit of $34,000,000 each. They will not be completed for several years. Each will have a speed of thirty knots, a radius of action of 7,000 miles, a crew of 1,500, a defensive armament only, and a carrying capacity of seventy-five airplanes.

The same amount of money, $68,000,000 would build twenty-seven airship carriers of airplanes, at a cost of $2,500,000 each. Each of these airship airplane carriers would have a speed of sixty miles an hour, a radius of action of 7,000 miles, a defensive armament, and a carrying capacity of thirty bombing and 150 pursuit airplanes. Each airship would be sustained by 5,000,000 cubic feet of helium gas, constituting a vessel twice the size of the *Los Angeles.*

The naval carriers of airplanes are limited in operations to navigable waters. The carrier airships would not be limited by sea or land. The naval carriers are subject to land, sea, or air attack. The airships would be subject only to air attack.

Three years are required to build the naval airplane carriers. Germany built an airship every two weeks, and it is believed that the United States could build at least one a month.

A naval airplane carrier is subject to danger from storms and rocky coasts. An airship can dodge storms over land or sea. If a naval vessel can ride out a storm, so can an airship.

The total number of airplanes that will be carried by the two naval carriers is 150. The total number of airplanes that could be carried by twenty-seven airships, costing no more than two naval carriers, would be 4,930.

The naval carriers will accompany the fleet, and will be defended by the fleet. They are unable to escape from an air attack, and can be defended only by airplanes against such an attack. The carrier airships could accompany the fleet and then extend their operations over land. They would be better defended against air attack because they would carry more airplanes. Instead of being subject to bombardment from coast fortifications they could sail untouched above such fortifications.

The launching of an airplane from a naval vessel's deck and the receiving of a plane upon deck is attended with risk; so is the launching and

receiving of an airplane by a mother airship, but both feats have been accomplished. The fact that an airplane's element is the air, while a naval carrier's element is the water, makes it improbable that launching and receiving will be as easy in a heavy sea as the launching and receiving of airplanes by airships, even in strong winds, where both vessels are in their element.

There is no need, of course, for twenty-seven airships carrying 4,900 airplanes. But there is need of economy and efficiency in providing for the national defense. If airships are better than naval vessels for carrying airplanes, they should be used.

Experiments must be made to develop the efficiency of naval carriers in rapidly bringing airplanes from the hold and launching them. Only ten planes can be handled at a time under present methods. Experiments must also be made to develop the best method of carrying planes by airship and for speedily launching and receiving them.

The superior speed of airships as compared with naval carriers would simplify problems of fuel replenishment. An airship can cross the ocean in one half the time consumed by a naval carrier. An airship is not stopped by a coast line, but can continue over continents. No objective is inaccessible to it. All of the enemy's lands and waters are subject to its attack. Airplanes carried by a naval carrier, however, are confined to operations within a radius of 200 miles or so from the carrier. They cannot cross continents.

Foreign nations will soon have airship carriers for their airplanes, thus bringing any part of the United States within their radius of action. The United States must have means of meeting sudden attacks by airplanes brought by airships across oceans to a point within 200 miles of the point of attack in the interior of this country. No method of meeting such attacks is in sight except by the building of airships capable of carrying airplanes.

First Magnesium Propeller Successfully Tested

Aviation, 2 March, 1925.—Another milestone in airplane propeller development was recently passed when on February 6, at Curtiss Field, Garden City, New York, the first flight with a single-piece magnesium propeller was successfully accomplished. The tests which were conducted on a *J1* Standard equipped with a Curtiss C6 motor flown by M. M. Merrill, one of the Curtiss pilots, were completely successful and showed promising performance. Previous to these tests, the propeller was given a ten-hour whirling test with 100 per cent overload (300 h.p) under direction of the Army Engineers at McCook Field, Dayton, and passed all requirements. These tests prove that magnesium alloy has the physical qualities necessary for propeller construction.

The significant feature of this alloy is its weight—twenty-five per cent lighter than duralumin. A magnesium propeller can utilize all the qualities which make metal propellers superior to wood and in addition, will weigh no more, and in many cases less, than a wooden propeller designed for the same type of machine.

This propeller was made from a rolled plate of magnesium alloy containing ninety-six per cent magnesium and four per cent aluminum, supplied by the American Magnesium Company of Niagara Falls, which Company deserves credit as it was only after research and experiment that it was able to produce a plate of sufficient size—the largest ever made. In fact, this development is a notable feat of metallurgy. Now that it is accomplished, the American Magnesium Company advises that it will be possible to build

plates large enough for any standard type of propeller. The finishing and twisting was done by the Curtiss Aeroplane and Motor Company, Inc., under the direction of S. A. Reed, inventor of the famous Curtiss-Reed Duralumin Propeller. The work was carried out under the Curtiss-Reed patents along lines substantially the same as those employed in the manufacture of duralumin propellers.

Successful Tests of the Loening Amphibian

Aviation, 2 March, 1925.—A new type of American metal airplane, the Loening Amphibian, which has been secretly under development for over a year, made its first public appearance on January 18 at Bolling Field, Washington, D. C. This ship, the first of an order of ten being built for the Army Air Service, was delivered by air piloted by Lieutenant Wendell H. Brookley, who flew the machine from the Loening factory on the East River, New York City, to Mitchel Field. From there he made the cross-country trip to Bolling Field. It was the first cross-country flight ever made by an amphibian flying boat in this country. Lieutenant Brookley's trip was without incident and he reported that the new craft handled well in every way.

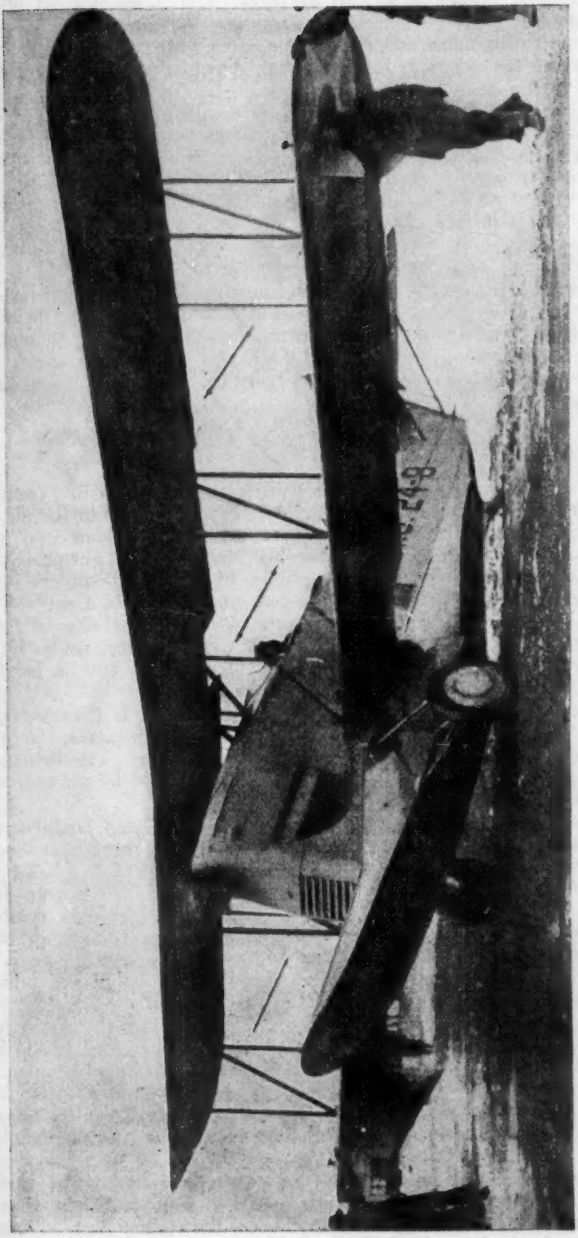
The following day Lieutenant Brookley demonstrated the capabilities of the Loening Amphibian to the Lampert Aircraft Investigating Committee with a masterful exhibition of flying. Taking off from the field with Fred Heckert, aeronautical engineer of McCook Field, as a passenger, Brookley landed shortly after to show the committee the adaptability of the craft as a land plane. Taking off again, the pilot folded up the landing wheels, and sideslipped down to the Naval Air Station at Anacostia which adjoins Bolling Field.

Four landings in the water were made altogether, and then, seeing Captain Robert Oldys of the office of the chief of Air Service idling about in the air in a De Haviland, Brookley climbed and came alongside. Both pilots then threw the throttles wide open, and down the field they came, wing and wing, with huge streams of black smoke trailing from the exhaust. Soon Captain Oldys was far outdistanced and the huge amphibian had beaten the DH. The inverted Liberty motor in the amphibian was turning up 1,700 r.p.m. for a speed of 127 miles an hour.

After further tests at Bolling Field the ship will be flown to Langley Field, Hampton, Virginia, where very extensive tests are to be made in the roughest sea conditions, as well as flights over land, under direction of officers of the A. S. Engineering Division.

Aviation experts, all over the world, have been awaiting with interest the demonstration of the Loening Amphibian, as it represents a very daring and novel metal design. For the first time, in the development of the art, the ordinary tractor type of biplane has been modified, so that the machine is capable of landing on either land or water, with ability to start from or alight on either, at a moment's notice. No extra floats or other devices are used, as the new design obtains its amphibious characteristics by the shape of the main fuselage body itself, the bottom of which is shaped like a flying boat hull. To this is attached a folding landing gear, an ingenious device, which is operated by an electric motor—the pilot merely throwing a switch in order to raise the wheels for water landing, or to lower them for alighting on the land.

As already demonstrated in flight, the new Loening Amphibian, in performance of speed and maneuverability, compares favorably with other airplanes of the same weight equipped with Liberty motors, such as the D.H. But the deeper metal body and the unit construction give it a strength and rigidity which should greatly increase the safety of the crew in case of accident. In the sand test, conducted by the Air Service at Dayton, this body



THE LOENING AMPHIBIAN

stood up without failure to a load of three or four times what is customarily applied.

In addition to the metal covering of the entire hull and body, the interior construction of the wings is largely metal, duralumin being the chief material used.

One of the most interesting features of the machine is the use of the Inverted Liberty Motor. This development places the bulk of the engine cylinders, etc., below the line of thrust of the propeller, so that clearance for the propeller is more readily obtained, and at the same time, the center of gravity of the weight is lowered several feet.

The Loening Amphibian weighs 3,300 pounds empty and 4,000 pounds loaded. It has seats for a crew of three and a gas capacity of 140 gallons, sufficient for a non-stop flight of 700 miles.

An interesting feature of the machine is that the forward projection of the boat-shaped body protects the propeller if landings have to be made in thick wheat fields or bushes, and prevents the machine from turning over on its nose, when hitting obstacles.

The new machine was designed and built by the Loening Aeronautical Engineering Corporation of New York.

Autogiro Gives Air Stability

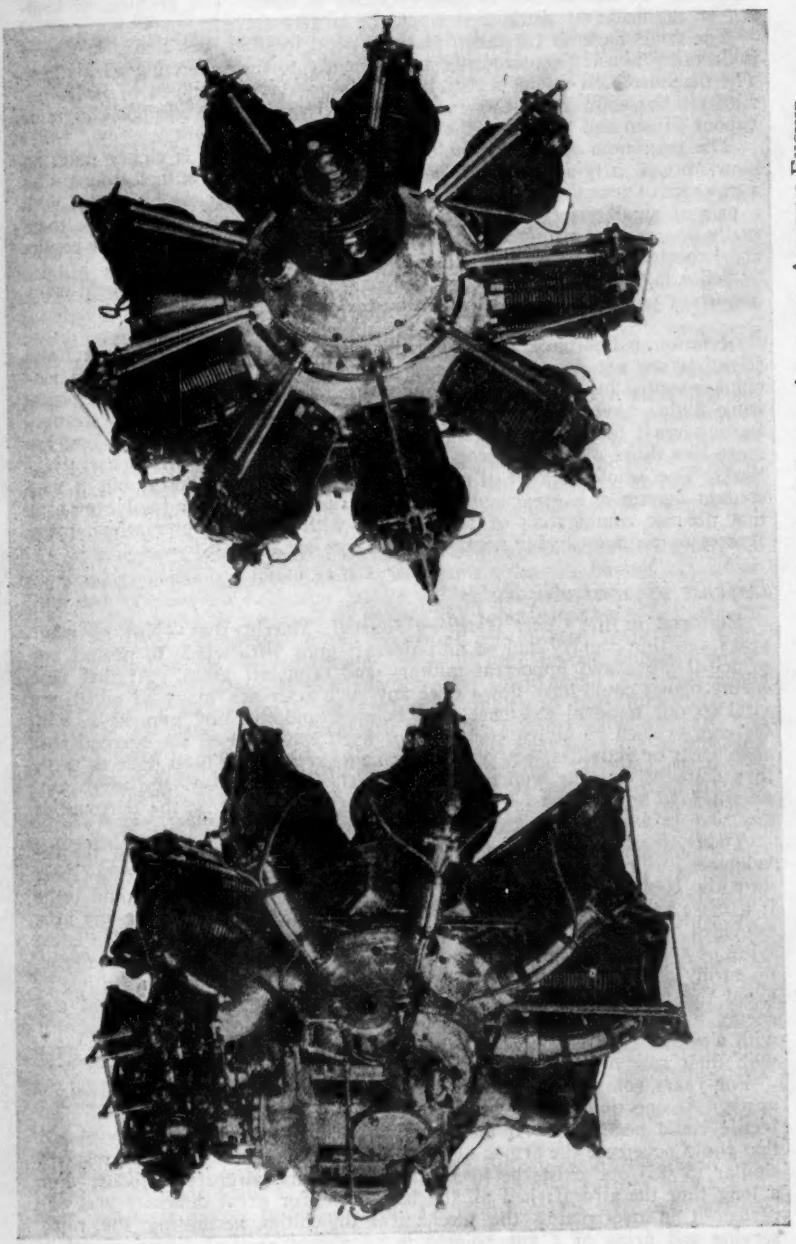
Christian Science Monitor.—Wingless Airplane, Fitted with Screw, Permits of Vertical Descent.—Madrid, 15 February.—Stability in the air, automatic banking and safety in landing are the three fundamental virtues claimed by Don Juan de la Cierva for his "autogiro" or giroplane, which created a word's record by making a flight of twelve kilometers in eight minutes twelve seconds at a height of over 100 meters in Cuatro Vientos aerodrome, Madrid, last week. As a proof of the simplicity of the machine, the pilot, Don Joaquin Loriga, of the Spanish Army, made the flight with merely a brief and purely theoretical explanation of how to handle the machine.

In an interview with the *Monitor* representative Señor la Cierva explained he had been experimenting with his machine for many years, the present model being the sixth. The machine is not a helicopter. The helicopter is worked by a lifting screw rotated on a horizontal plane by an engine, and the machine takes off vertically.

The "autogiro" takes off like an ordinary airplane and lands vertically or in airplane fashion, at will. Indeed it is nothing more than ordinary airplane stripped of its wings and fitted with a large four-bladed screw turned in a vertical shaft. The machine is propelled by its own engine, and the blades, which are tilted slightly out of the horizontal, rotate like weather vanes by the force of the wind, completely independent of the engine and the pilot. The blades are fitted to the shaft in such a way as automatically and on the centrifugal method to imitate the rising and falling of a bird's wings.

Señor la Cierva claims his "autogiro" achieves a greater security and stability in the air than the airplane, particularly in banking, as the blades automatically move at right angles to the vertical shaft. The turn is as natural as that of a bicycle. The airplane depends on its speed for its stability and eighty per cent of the airplane accidents are caused, according to Señor la Cierva, by sudden landings on bad ground, or by landing at high speed.

The "autogiro" is able to descend vertically without a yard of variation. It can also descend quickly like an airplane to a suitable height above the ground, where the landing spot can be chosen, the engine shut off, and the machine can descend vertically and slowly and alight like a bird. The



FRONT AND REAR VIEWS OF THE NEW 400H.P. WRIGHT "CYCLONE" RADIAL AIR-COOLED AVIATION ENGINE

advantage of this method in rough country is clear. The problem of landing on the decks of battleships would be largely solved.

The trials have so far taken place in good weather, but Señor la Cierva is devoting himself continuously and patiently to the perfecting of his idea. The machine used at the recent trials was an Avron stripped of its wings, with 110-horsepower Le Rhône engine. The flying weight was 800 kilograms (about fifteen and three-fourths hundred weight.

The maximum speed attainable on this small machine is eighty miles an hour, though fifty-six miles an hour is all that has been actually done. As a measure of precaution during experiments the machine has been fitted with a pair of small safety wings, though both inventor and pilot declare them really unnecessary. Further trials at which greater speeds and better results are expected will be held soon.

Señor la Cierva is the son of Don Juan de la Cierva, who has held many important posts in Conservative Cabinets.

Aviation, 9 February, 1925.—Fortunately, forward looking engineers and scientists are not wanting. Witness the "autogiro," a revolving wing machine invented by the Spanish engineer La Cierva, with which some promising flights have been accomplished during the past year. This strange-looking craft flies much like an airplane, but its take-off and landing are more like those of a helicopter, the flight trajectory being then nearly vertical. The whole idea of this machine is still in its infancy, but it may contain a germ of a great and fundamental improvement, and solve perhaps that difficult combination of the airplane with the helicopter which many foresee as an unescapable necessity for large air liners.

Defense Against Air Raids

Editorial in the *Coast Artillery Journal*, March, 1925.—Not so many years ago this country had no anti-aircraft guns with which to protect our principal cities and important military and economic areas. At that time enemy planes could have flown over any such activities, many of which are vital to our national existence, and bombed and machine gunned at will. Of course, such an attack could not of itself have caused the surrender of such areas or activities, but sufficient damage could have been done to them, in a material way, as well as to the morale of our troops and civil communities, to have had a very decided, if not vital, effect on the outcome of any war in which we might have been engaged.

Today, thanks to the enormous strides that have been made in the development of our anti-aircraft guns, conditions are vastly different. Even with the equipment it now has, America's anti-aircraft troops would make it a most hazardous undertaking for an enemy flier to soar over any area defended by them. These troops are not at present equipped with the latest types of anti-aircraft cannon and machine guns. When they are so equipped, no enemy bombing plane will be able to fly at a sufficiently high altitude to avoid the probability of being quickly shot down by them, nor will any enemy fighting plane be able to attack at low altitudes without being met with a withering fire from our newly developed high-powered machine guns with their rate of fire of 450 rounds per minute.

For years competition between battleship armor and projectiles went on apace. At one time a ship would be launched carrying armor that no projectile could penetrate. At another time a projectile would be developed that could penetrate the armor of any ship. A competition in many respects similar to this one exists between aircraft and anti-aircraft weapons. For a long time the aircraft had all the best of it, for great difficulty was experienced in overcoming the mechanical difficulties permitting the rapid serving and firing of a gun pointed in an almost vertical direction and in

designing a gun that could fire a projectile to the elevation at which a plane could fly. Today, however, anti-aircraft guns are being built with a straight-up range far in excess of that to which any loaded mombing plane so far developed can reach. Should this country be invaded tomorrow and such guns be furnished for the defense of our principal cities, the inhabitants thereof would be adequately protected from the horrors of a bombing raid.

The Wright Cyclone Aviation Engine

Aviation, 9 March, 1925.—Slightly more than a year ago, the Bureau of Aeronautics of the Navy Department felt the need of an air-cooled power-plant to replace the Liberty engine in certain types of ships, principally torpedo and observation planes. This requirement necessitated an air-cooled power plant of larger displacement than had been constructed in this country before. To add to the difficulty of designing such an engine, a limitation was placed on the diameter in order to keep the parasite resistance as low as possible.

A contract was given the Wright Aeronautical Corporation of Paterson, New Jersey, for the development and construction of three such engines, into which have gone the combined experience of the Lawrance as well as the Wright Companies. In this connection, it is interesting to note that the Wright Company, in 1920, won an Army design competition for a 300 h.p. air-cooled radial engine, and subsequently built three engines, known as the Model R-1, which were the first large air-cooled engines to be built in the United States.

The Wright "Cyclone" or P-1, as the new engine was called in the original engineering plans, is a fixed radial, with nine cylinders having a six-inch bore and six-and-one-half-inch stroke. The total displacement is 1,650 cubic inches, which is the same as that of the Liberty engine.

The external appearance of the engine, as can be seen from the accompanying illustrations, is remarkably clean. There is one unique feature, that will be immediately noticed: namely, the valve gear. The valves, instead of being located in a plane at right angles to the crankshaft, are located in the plane of the crankshaft with the exhaust valve forward and the inlet valve to the rear. The operation of the exhaust valve is orthodox by means of a push rod and rocker arm, but the inlet valve is operated by a pull rod across the top of the cylinder. The valve gear is located in front of the engine, and all the accessories at the rear, including carburetors, magnetos, pumps, strainers, etc.

The cylinders have steel sleeves, steel fins and aluminum heads.

The development of this engine followed the usual practice of the Wright Company, namely, the design and development of a single cylinder, followed by the complete design of the engine and the construction of the first one. It was found that the original limitation of diameter was detrimental to the proper operation of the engine, so that it was necessary to increase the length of the cylinder slightly, although even with this slight increase the diameter of the engine from the tops of the cylinders is very much less than any engine of this power heretofore constructed. In fact, the external diameter of the Cyclone is no greater than that of the Wright Whirlwind 200 h.p. radial engine, which, it will be seen, is a remarkable tribute to the engineering ability of the Wright Company.

A fifty-hour test has recently been completed, which was run in accordance with the Navy's Specification E-4-D.

As this engine has been developed for the Bureau of Aeronautics, Navy Department, we are not at liberty at this time to give further information in regard to it, except to add that the Cyclone develops well over 400 h.p. at a specific weight of less than two pounds per horse power.

Extract from Report of Navy Special Board Bearing on Proposed Department of Aeronautics

Proposed Department of Aeronautics.—

201. In the hearings before the board there developed a small minority among the witnesses in favor of setting up an independent air department of the government, with its cabinet officer and independent functions, and a united air service coordinate in the national defense with the War Department and the Navy Department, to be called the department of aeronautics.

202. For a united service the board had affirmative opinions from officers of the Army Air Service, a representative of the United States Post Office Department, a publisher of an aviation periodical, and a college professor of aeronautical engineering.

203. Protagonists of a united air service rely for one of their arguments on the example of some European powers. The problems of those powers in naval defense are different from ours. Their potential enemies are at their doors. Our problems have to do not only with defending our home shores, but also with defending our national rights and interests far from our home coasts. We have no probable enemies on our frontiers. Other arguments are based on the claim that aircraft have capabilities that are shown not to exist. Another argument is that there is money wasted in duplication of effort. Testimony from members of the National Advisory Committee for Aeronautics is to the effect that the operations of this body and the coordination of the Army Air Service and the naval Bureau of Aeronautics through the joint Army and Navy Aeronautical Board are making notable progress toward preventing duplication. Civilian experts have testified that the Army and Navy require and use types of aircraft so distinct from each other that each, for best results, will have to go on developing to meet its own needs. The board believes that one of the reasons why American aircraft are superior in performance to foreign aircraft is because of the healthy competition existing between the Army and Navy Air Services. A united department of aeronautics would do much toward destroying this desirable competition. In this connection testimony before the board is to the effect that greater experimental work has been carried on under the naval Bureau of Aeronautics than anywhere else.

204. Those opposed to a united air service include officers of the naval Bureau of Aeronautics and all other naval officers, active and retired, who appeared before the board. Testimony was adduced to the effect that the majorities of the National Advisory Committee for Aeronautics and of the Aero Club were opposed to the united air service idea. Among others voicing their opposition to it were general officers of the Army, representing the Army General Staff, the Coast Artillery, and the Ordnance Department of the Army, three aeronautical engineers of national reputation, and three representatives of the aircraft industry.

205. This proposition needs to be examined from the standpoints of—

I. Whether it will help or hinder the Navy to defend the country's rights and interests.

II. Coordination of Department of Aeronautics with either Army or Navy, or both.

III. The relation of the Department of Aeronautics to national defense.

IV. Economy.

I. Will an Independent Department of Aeronautics Help or Hinder the Navy to Defend the Country's Rights and Interests?

206. In examining this question it is necessary to consider:

(*a*) The limitations of aircraft.

(*b*) The mission of the Navy.

(*c*) The relation of the Naval Air Force to the Navy.

(A) THE LIMITATIONS OF AIRCRAFT

207. The evidence shows that—

Anti-aircraft gun accuracy is advancing with the increased accuracy of bombing. Defense is developing against aircraft, just as it has always developed against a new weapon.

Airplanes can not accomplish anything beyond their radius from bases, therefore an enemy blockade out of reach of aircraft would ultimately win.

An air force operating independently can not by itself win a war either at the present time or at any time in the future.

An air force acting alone can not obtain a final decision against forces on the surface.

To win a war a combatant must gain a final decision.

To gain a final decision, a combatant must sustain an offensive, then occupy and control first sea areas, then land areas.

Aircraft alone can not sustain an offensive. An independent air offensive is essentially a raid.

Aircraft acting alone can not occupy and control either sea areas or land areas.

Aircraft attack, when met by equal aircraft or good anti-aircraft guns, will not be able to prevent the transport of troops.

208. The world's oversea commerce is now and will continue to be carried on the surface, and therefore the Navy must control on the sea, under the sea, and in the air above it. Submarines and aircraft are important auxiliaries to the surface Navy. The airplane must return to the surface for fuel and supplies. An airplane not in the air has no value in battle; it can accomplish little in fog or heavy gales. (During the world flight army fliers lost one month in the vicinity of the Aleutians and Puriles, due to adverse weather.)

(B) THE MISSION OF THE NAVY

209. The mission of the Navy is to defend our national rights and interests.

210. Our national rights and interests are: Our national sojourning abroad, our $8,000,000,000 yearly foreign trade, 1,260 American merchant ships scattered all over the world and along our own coast on 70,000 miles of trade routes, the Panama Canal, the Monroe doctrine, the open-door doctrine, policies that protect our standard of living, outlying possessions.

211. Should any of these rights or interests be attacked, the Navy, while having a defensive motive, would have to employ offensive operations to crush forces attempting to deny us our rights.

212. The object of the Navy would be: first, to destroy or blockade the enemy fleet in order; second, to protect our commerce; then, third, to destroy the enemy's commerce in order; fourth, to bring economic pressure to bear on him; and if our rights still continued to be denied; fifth, to transport the Army in order; sixth, to break down remaining enemy resistance.

213. It follows that normally the ultimate force to be used in national defense is the Army and that the only arm of the Army that can ultimately bring about a decision favorable to national defense is the Infantry.

214. Therefore all other arms of the Army have for their object to help the Infantry to obtain the decision; and all peace and war operations of the Navy look ultimately to transporting, protecting, and supplying the Army (the Infantry and its supporting arms) up to and through its decisive campaign.

215. There is no development of aircraft possible that can take over the mission of the surface Navy.

(c) THE RELATION OF THE NAVAL AIR FORCE FORCE TO THE NAVY

216. The aim of the Navy is—

To carry aircraft into operations leading up to battle and into battle on board of airplane carriers, battleships, cruisers and merchantmen converted into carriers and tenders.

To develop long-range scouting and attack seaplanes, capable of cruising with the fleet, based on mobile tenders.

To develop this air force to be superior in numbers, performance and personnel to any that may be brought against the fleet on the high seas.

217. Aviation being thus a component part of the fleet, the fleet as a whole can not be efficiently trained or operated with its air force owing its allegiance to another department of the government.

218. Attack by aircraft at sea is an extension through the air of the attack by the ships. All attacking planes must return to the ships from which launched. Every attack launched from ships whether by guns, torpedoes or airplanes should be wholly controlled by the Navy.

219. Unless naval aviation is under naval control, works under the same discipline, acts in accordance with Navy plans under precisely the same condition as naval gunnery or naval engineering, it will not give the best results in battle. Naval aviation, like naval gunnery and naval engineering, must fully understand its exact functions in working with other elements, must know the needs of the other elements, be in full sympathy with them, think in the same naval atmosphere, and have the same *esprit de corps;* otherwise effective battle control is impossible. No aviation force can realize the above conditions unless it be an integral part of the Navy not only during battle but also during the entire period of service.

220. The round-the-world flight by the Army aviators demonstrated beyond argument that seagoing aviation is dependent on surface ships. In addition to supplies transported by merchant ships and to assistance rendered by Coast Guard vessels, there were one or more ships of the Navy assisting the flight during 128 days of the flight. In the aggregate thirty-three ships manned by 339 officers and 5,062 men had some part in this service. The aggregate distance steamed was 135,566 ship miles; the total fuel used was 6,299,941 gallons, costing $321,157.50. If the same flight were made again, it is a fair presumption that approximately the same precautions and the same service of surface ships would again be required.

221. It is the opinion of the board that the separation of the air force from the Navy and its incorporation in an independent department would hinder the Navy in the execution of its mission.

II. COORDINATION OF DEPARTMENT OF AERONAUTICS WITH EITHER ARMY OR NAVY, OR WITH BOTH

222. The United States War and Navy Departments have long recognized the necessity of close cooperation, and have for some time given earnest attention and effort to accomplish thorough cooperation through decisions reached by the Army and Navy Joint Board, cooperation between Army General Staff and Naval Operations, cooperation between corps area commanders and fleet and district commanders, and cooperation between Army War College and Naval War College. If now one more independent service should be introduced into the problem of coordination, especially a service whose operations are dependent on the other two services, the frictions and difficulties of conjoint operations will be greatly increased.

III. THE RELATION OF THE DEPARTMENT OF AERONAUTICS TO NATIONAL DEFENSE

223. The country should be prepared to defend its interests at sea and on land. The Navy with all necessary component elements should maintain that

defense so far from our home coasts that our people can continue to carry on business in the security of domestic tranquility. It is historically true that the country possessing sea power to be reckoned with gets fair treatment in international dealings.

224. A department of aeronautics, which would have cognizance of aircraft alone, would be incapable in the nature of things of having any influence on sea power beyond the limited range of its aircraft from our shores, and therefore incapable of exercising any restraining influence or of exacting fair play where our interests are involved.

IV. Economy

225. The creation of a department of aeronautics would require overhead expenses comparable to those of other government departments amounting to many millions annually. This expense is now largely avoided by the existing arrangement.

226. The transfer, as proposed in H. R. 10147, to a department of aeronautics of all types of aircraft, and any other means of transportation, including ships, vessels, boats and automobiles or other motor vehicles now in use or on hand, all lands, docks, wharves, and all other property heretofore used by the Navy Department and all other departments in connection with aircraft would merely build up another navy in the department of aeronautics; the transfer to a department of aeronautics of all antiaircraft artillery now mounted in the national defense scheme merely builds up within the department or aeronautics another artillery corps, and does not diminish the need for anti-aircraft artillery by the Army or Navy.

227. The expense of establishing an aeronautical academy or academies and staff corps in a department of aeronautics, including supply, engineering, medical, and legal corps, with hospitals and warehouses, lays the foundations for future annual appropriations that will probably equal or exceed those required by the Army or Navy.

228. Aeronautical department flying officers carried on board ships of the fleet would not be capable of performing a naval officer's duties, not capable of standing watch, nor of helping in other ships' duties as naval aviators now do.

229. The existing administrative, industrial, and scientific organization of our Navy Department and all of its resources have been taken advantage of in the development of naval aviation, with little additional overhead beyond the general overhead charges of the department.

230. Naval aviation must be developed along the lines adapted primarily to the needs of the Navy. Only the Navy can know what is really needed, and only the Navy, therefore, can take care of such development, as it has done in the past through unremitting research, investigation, inspection, designing, and redesigning.

231. The development of naval aviation ordnance, as it is today, for instance, has been carried on by existing naval ordnance agencies. This development, which under a department of aeronautics would require a vast expenditure of money for separate ordnance laboratory and various other technical establishments, has been accomplished practically without cost to the country above that incurred in the general work of the Navy Department. All these activities came within the daily work of the various establishments of the Navy, which exist now and must continue to exist, even though part of their work be taken away.

232. The same is true in regard to the activities of the Bureau of Engineering in the development of naval aviation.

233. Purchases of material, disbursing, supply of provisions and clothing, and general accounting for all branches of the Navy, including aviation, are performed by the supply corps. The storage, issue, and transportation of

aviation supplies for the Navy are accomplished as an incidental function of that bureau. The necessity for this service would require a substantial duplication of the supply corps of the Navy in a Department of Aeronautics.

234. In the production of naval types of planes and their development for the work of the fleet, full use has been made of the services of the expert designers and engineers of the Navy. Experienced naval architects of the construction corps of the Navy, schooled in the design and construction of modern naval vessels, have provided a large part of the technical skill for aircraft development. Examples of this are the production of service types of planes now with the fleet, the development of the catapult for launching planes from naval ships, the development of the arresting gear on the decks of airplane carriers, and the building of the airship *Shenandoah*. This work could only have been accomplished in a department of aeronautics by the creation of a distinct corps of technicians.

235. All inspection work is carried on by the regular inspection service of the Navy; medical service is provided by the naval medical corps; recruiting, training, and administration of the personnel is carried on by the personnel division of the Bureau of Navigation, which bureau also develops and supplies aircraft instruments and navigational equipment peculiar to the need of naval aviation; intelligence work in the form of accumulating data and information on world progress in aviation is done by the office of Naval Intelligence, and communication work is conducted under the office of Naval Communications.

236. Full use is made of the existing industrial facilities of navy yards and naval stations to meet the Navy's aviation requirements, and the personnel of the Bureau of Yards and Docks, having cognizance of all public works of the Navy, is fully able to cope with the requirements of our air stations on shore.

237. To divorce aviation from the regular naval establishment would necessitate the creation of new agencies for performing all of the functions enumerated above. It would result in inevitable duplication, and duplication is only another term for increasing expense.

238. In short, the outline of the contemplated functions of a department or aeronautics clearly shows that ultimately such a department will result in more duplication of services and functions now inherent in the Army and Navy than the present trifling duplication that is sought to be removed.

239. Testimony indicates that the agitation for a department of aeronautics is due in a large measure to a feeling of unrest among some of the pilots in both services, and that the causes of this unrest are:

(1) Unsatisfactory promotion from their point of view.

(2) A desire to be always under the command from the top down of practical flying officers.

(3) A belief that there exists a lack of sympathy for them on the part of the senior officers of both Army and Navy.

240. As regards unsatisfactory promotion from their point of view flying officers visualize in a united air service a great expansion of numbers wherein all present flying officers will enter the new organization with greatly increased rank and pay.

241. As regards a desire to be always under the command from the top down of practical flying officers, it must be borne in mind that the naval air force is not only a detail of the general service, but also is necessarily an activity of comparatively recent origin. The time is approaching when all immediate commanders of flying squadrons will be practical flying officers. It can not be expected that flag officers in command will always be practical flying officers, any more than it is reasonable that officers specializing in naval engineering or naval ordnance shall demand that they shall always be

commanded by flag officers who are specialists in naval engineering or naval ordnance.

242. As regards a belief that there exists a lack of sympathy for them on the part of the senior officers of both Army and Navy, it is possible that this arises because the higher authorities in both Army and Navy understand the serious limitations in war operations in the air. These limitations are not admitted by enthusiastic flying officers who think that the capabilities of aircraft in warfare are practically unlimited. The higher authoriites have to be guided by the actual limitations as well as by the lessons of war. Enthusiastic flying officers fail to consider that in battle every airplane not actually in the air is worth zero at that moment. Another feeling among the younger naval flying officers is that the Navy has been slow to develop a policy of detail for duty that would take care of the future of these young officers. This source of unrest can be eliminated by a fixed policy which assures to the navy pilot a knowledge of his future. The board is of the firm belief that detail to aviation duty should have the same place in the mind of the Navy as have submarine duty, engineering duty, ordnance duty, etc., and that there is no reason why young officers should not qualify in aviation just as they qualify in other duties of a naval officer. It requires less time to qualify a young officer in flying than to put him through the existing postgraduate course in engineering or ordnance. The board firmly believes that flying officers must be above all naval officers first.

Conclusions

258. After mature deliberation the board has arrived at the following conclusions:

259. It is a fundamental truth that sea power is necessary to the commercial life and prosperity of a nation that is engaged in overseas commerce.

260. The three most important elements of sea power are:

(*a*) A powerful and efficient navy.

(*b*) Properly equipped and defended bases for the use of the fleet in areas where hostilities may occur.

(*c*) A merchant marine adequate to the task of carrying on the nation's trade and of supplying its fleet in time of war.

261. The mission of the Navy is to support the national policies and guard the national interests in all parts of the world.

262. The Navy of the United States should be maintained in sufficient strength to support its policies and its commerce, and to guard its continental and overseas possessions.

263. The policy consistently urged by the Navy Department is sound; i. e., to create, maintain, and operate a Navy second to none, and in conformity with the ratio for capital ships established by the treaty limiting naval armament.

264. The fleet, which includes all types of combatant and necessary auxiliary units, is the ultimate force employed in the exercise of sea power.

265. A properly constituted fleet consists of battleships, battle cruisers, cruisers, aircraft carriers, aircraft, destroyers, submarines, mine layers, and auxiliaries.

266. The battleship is the element of ultimate force in the fleet, and all other elements are contributory to the fulfillment of its function as the final arbiter in sea warfare.

267. The other elements have their important, and at times indispensable, functions.

268. From time to time apparent threats to the supremacy of the battleship have appeared. Each has resulted in some modification of its design and in the methods of its employment in war, but its supremacy remains.

269. With the invention and development of offensive weapons have always come the counter invention and development of defensive means and methods, so that in the end a fair balance is struck between them. The history of the gun and armor, and of the torpedo and interior subdivision, merely repeats the process by which offense always begets defense.

270. Aviation has introduced a new and highly important factor in warfare both on the land and on the sea. It was utilized on an enormous scale and with great effectiveness in land operations during the World War, but did not seriously influence sea operations. Its influence on naval warfare undoubtedly will increase in the future, but the prediction that it will assume paramount importance in sea warfare will not be realized.

271. The airplane (heavier-than-air) is inherently limited in performance by physical laws.

272. The airship (lighter-than-air) has some valuable characteristics, but, due to great vulnerability, is of doubtful value in war.

273. Aircraft cannot operate from territory that is not controlled by the military or naval forces of their own country.

274. Airplanes can not occupy territory, nor can they exercise control of the sea.

275. Airplanes can not reach distant overseas areas under their own power with any effective military load, and therefore can not operate there offensively or defensively until supplied with weapons and fuel.

276. Airplanes can not fulfill the functions of the service of supply for themselves or for other forces in distant overseas areas.

277. Airplanes can not fly across the Atlantic Ocean or the Pacific Ocean to any point on our coasts or within our continental territory with bombs heavy enough to do any serious damage. The situation as to other continental or insular powers having potential enemies contiguous to their borders is wholly different and bears no analogy to ours.

278. Within a distance of 250 miles from their bases or carriers, airplanes may constitute a serious threat to surface ships, land forces, cities, and industrial centers, for the reason that they can transport to the above distance heavy bombs of 2,000 pounds in weight at present, which may reach 4,000 pounds in the future. To answer such a threat anti-aircraft defense must be provided, and hostile carriers should not be allowed to approach within that distance of our coast.

279. The battleship of today, while not invulnerable to airplane attack, still possesses very efficient structural protection, as shown by the experiments on the *Washington*. The battleship of the future can be so designed as to distribution of her armor on decks and sides, and as to interior subdivision, that she will not be subject to fatal damage from the air. The effect of plunging long-range gun projectile hits on a ship's deck has now become closely analogous to the effect of hits by heavy aerial bombs. By armoring the battleship's deck with six to seven inches of armor, we at one and the same time effectively meet any practicable attack from the air and also the attack by gun projectiles fired at the greatest probable battle ranges. The interior subdivision will resist any mining effect from aerial bombs. It can not be said therefore that air attack has rendered the battleship obsolete.

280. The observation value of the airplane has been extended to assisting gunnery by observing and reporting the fall of shot relative to the target. This has given great value to high angle gun elevation, has made possible the accurate control of fire at long ranges, and has greatly increased its effectiveness.

281. Airplanes have demonstrated their great value to the fleet in scouting, observation, and bombing. The use of torpedo planes, gas, and smoke screens, is still in the process of development. Airplane carriers are necessary elements of a properly constituted fleet to carry airplanes to the scene of action.

282. Aviation has taken its place as an element of the fleet and can not se separated from it.

283. The separation of aviation from the Navy and its incorporation in a separate department of the government would be most injurious to the continued efficiency of the fleet in the performance of its mission.

284. The development of commercial aviation in this country will prove of very great value to the Army and the Navy by stimulating further development of aircraft and expanding the industry. It will furnish a reserve of pilots, observers, and aviation ground forces for times of emergency. It should be encouraged by all the appropriate agencies of the federal government. Establishment of airways, inspection of aircraft, examination of pilots, and licensing of machines and pilots should be regulated by federal statutes.

285. The further development of military aviation for both the land and sea forces should be encouraged liberally, in order that this very important element intimately connected with the operations of the Army and the Navy in the national defense may be brought to the high point of efficiency necessary to insure the national safety.

286. Cruisers are indispensable to the fleet in war for scouting and screening, attack on enemy commerce, defense of our commerce, patrolling trade routes, and participating in major engagements by operating against enemy light forces, as well as for many other duties.

287. The destroyer is designed to use its torpedo against larger vessels. It can engage other destroyers and small vessels with its guns, submarines with its depth charges, and is of great value in the screen.

288. Substantial progress has been made in the development of the submarine since the World War. Its radius of action and surface speed have been so increased that it will be of great value in distant scouting, mine laying, and offensive operations with the fleet.

289. The Navy Department policy (promulgated December 1, 1922), which was formulated immediately following the treaty limiting naval armament, takes account of the development and potentiality of aircraft and submarines, is sound, and should be adhered to. The naval air policy met with the approval of every witness who appeared before the board, including officers of the Army, distinguished civilian aeronautical authorities, and representatives of the aircraft industry.

290. Our national policies are all defensive and are well known to the world. Foreign powers are embarked on building programs designed to augment their fleets materially in types not limited by the treaty limiting naval armament. As long as foreign powers continue such policy the United States is forced to do likewise.

Recommendations

291. The board submits the following recommendations:

Battleships.—Maintain the treaty strength; keep modernized under the treaty; apply, under treaty, every device or change that will increase effectiveness of weapons; keep in high state of organization and training.

Cruisers, destroyer leaders, and destroyers.—Maintain a tonnage based on a 5-5-3 ratio.

Fleet submarines.—Maintain a tonnage strength based on a 5-5-3 ratio.

Aircraft carriers.—Maintain at the strength allowed by treaty.

Aircraft.—Maintain in numbers, in performance, and in personnel as required to insure a 5-5-3 ratio in naval air strength.

Tenders and auxiliaries.—Provide and maintain as required to support the combatant forces.

292. Toward the accomplishment of the above it is recommended further:

(*a*) That the six coal-burning battleships *New York, Texas, Wyoming, Arkansas, Utah* and *Florida* be modernized, as authorized by Congress, without delay.

(*b*) That the seven battleships *New Mexico, Mississippi, Idaho, Pennsylvania, Arizona, Oklahoma* and *Nevada* be modernized, as allowed by the treaty, as soon as possible.

(*c*) That the eight 10,000-ton cruisers, already authorized by Congress, be built without delay.

(*d*) That the three remaining fleet submarines, already authorized by Congress, be laid down during the fiscal year 1927.

(*e*) That a progressive and adequate airplane building program be authorized to insure to the fleet a complete outfit of up-to-date planes, with fifty per cent replacements in reserve, as well as the necessary training planes, at a total expenditure for the first year of $20,000,000.

(*f*) That the completion of the aircraft carriers *Lexington* and *Saratoga* be expedited.

(*g*) That an aircraft carrier of about 23,000 tons be authorized and laid down without unnecessary delay.

(*h*) That the twenty-year Navy building program prepared by the General Board be authorized.

(*i*) That the course in aeronautics at the Naval Academy be extended.

(*j*) That in the future graduates of the Naval Academy be assigned to aviation duty, for qualification as pilots or as observers, in so far as the other requirements of the service will permit, after they have completed at least two years' sea service.

(*k*) That the Navy Department establish a definite policy to govern the assignment of naval personnel to aviation duty, the length of such assignment, and determine their obligations to their other naval duties.

The Issues Joined

Aviation, 9 March, 1925.—So many assertions and denials regarding aircraft have come out of Washington during February that it has been difficult to determine just what the exact differences between airmen and others have been.

The report of the Special Naval Board states the Navy's point of view and perhaps it will bring the whole controversy more definitely to the point if an effort is made to state the divergences of opinion. While it would require many pages to give the supporting data for each claim, the issues of the discussion can be briefly stated in the following terms. (The pages refer to the naval report.)

Airmen assert that the mission of the Navy has been greatly changed by aircraft. The board does not give any evidence of this change either as regards naval warfare or the control of shipping (p. 6).

Airmen claim that aircraft bomb attack is directed against the bottoms of battleships where they are most vulnerable. The board asserts that aircraft bombs exploding alongside would cause "few injuries and practically no loss of life" underdecks and that "a repair party immediately after each explosion could stop the minor leaks by wooden plugs and wedges" (p. 26).

Airmen claim that the only defense against air attack is by aircraft. The board believes that "in defending a battleship against air attack, the anti-aircraft gun probably holds first place" (p. 19).

Airmen declare that troops cannot be transported and landed from ships under naval protection where there is aircraft defense. The board affirms "no development of aircraft possible can take over the mission of the surface Navy, one object of which is to transport the Army, in order to break down remaining enemy resistance" (p. 66, also p. 6). "Aircraft attack, when met by equal aircraft or good anti-aircraft guns, will not be able to prevent the transport of troops" (p. 65).

Airmen predict that future wars will commence in the air and that by the use of gas, explosives and ground attack aircraft will paralyze military,

naval and civilian activities before land and sea forces can come into action. The board, while admitting that this "might conceivably play a tremendously important part 'in Europe,' air power is not so vitally important to us" (p. 10).

Airmen claim that aeronautical engineers can now produce aircraft which can carry out all the operations required for making the air force the first line of defense of any country. The board limits the increase of performance to thirty per cent (p. 43).

Airmen point to the expenditure of $433,000,000 in five years by scattered government services without adequate results as a chief argument for establishing a department of aeronautics. The board asserts that the department would require overhead expenses amounting to "many millions annually now largely avoided by the existing arrangement" (p. 68).

Airmen assert that aircraft alone with adequate equipment can sustain an offensive. The board denies this and states that an independent air offensive is essentially a raid (p. 65).

Airmen assert that the British are maintaining the occupation and control of Mesopotamia by means of an air force and that other areas can be controlled similarly. The board definitely asserts that aircraft acting alone cannot occupy or control either sea or land areas.

Airmen claim that a unification of procurement, operation and maintenance of aircraft would cause great savings. The board meets this assertion with the statement that it would require a substantial duplication of the supply corps of the Navy (p. 61).

Airmen regret that there has seemed to be meager support given to aviation development by the senior officers of the Navy. The board excuses this attitude by declaring for some "fixed policy" and placing aviation "in the mind of the Navy" on a par with "submarine duty, engineering duty, ordnance duty, etc." (p. 71).

The issues are joined. Let the best proof win.

RADIO

A Survey of Current Progress in Radio Engineering

By Dr. J. H. Dellinger,* *Journal of the Western Society of Engineers,* February, 1925.—There is no need for more sensitive radio receiving sets than we now have available according to the author of this paper. Use of higher frequencies or shorter wave lengths offers possibilities of greater use of radio, longer range and less interference. Directive transmission is becoming perfected to a high degree which taken with automatic relaying may result in an entirely new communication system. Closer regulation of stations has reduced much of the interference. This is the day of radio engineering or perfection rather than pioneering of inventions.—EDITOR.

A survey of progress in radio reveals that this is the era of radio engineering. This statement does not refer to the importance or extent of radio engineering but to the type of development now going on in radio as compared with that of past years. Relatively speaking, radio has been crude heretofore, whereas the progress now being made is not merely empirical but is more largely characterized by actual engineering development. We now have not so much the invention of devices as the perfection of them. This statement is very general. There have, of course, been triumphs of engineering in the past history of radio, and on the other hand the process of "cut and try" will continue to be used in the future. Nevertheless, broadly speaking, radio engineering has now definitely taken form and is the tool by which further progress in radio will be wrought.

While a number of outstanding recent developments arrest the attention, it is also true that very substantial progress is being made all along the line of radio engineering. Thus, in the development of new and improved radio

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communication methods or systems, we have marked extension of the available frequency range, great improvements in directive radio transmission, advances in the perfection of selective radio systems, and engineering development of line-radio or carrier-current communication. Among radio devices and applications of radio there is outstanding progress on radio beacons, on the uses of radio for aircraft navigation, on direction finders, and on radio vision. In the field of research and study of the problems of radio, we have important progress now going on in radio measurements, in standardization of apparatus, in the study and mitigation of the vagaries of wave propagation and atmospheric disturbances, and in the wide reaches of the interference problem.

We have now progressed from Marconi and the coherer in 1896, through the invention of the electron tube by DeForest in 1906, past the development of amplifiers by the French and other engineers in 1914, and have found a way to fit into the scheme of radio the great development of broadcasting which began in 1920. While the public acclaim of broadcasting continues and there is still wonderful progress ahead in broadcasting, the obsession of broadcasting has perhaps begun to subside and radio engineering is no longer monopolized and obscured by it.

Little will be said about broadcast receiving circuits in this discussion. A very large part of the more popular literature on radio is devoted to this one subject. While many interesting and valuable things in this field are constantly appearing, there has been very little basically new in radio receiving apparatus in many years. It is also coming to be realized that it is not worth while to increase the sensitivity of receiving sets further. The slight electrical discharges always going on in the atmosphere cause a certain background of noise in a radio receiving set, and these discharges can probably never be prevented any more than variations of weather can be prevented. They are thus a sort of natural limit to what a receiving set can do, for if the waves from a distant station are weaker than the average of these atmospheric disturbances, no increase of amplification in the receiving set can bring in the distant station without the interference. It is therefore not the sensitivity of receiving sets which gives the real limit to the distance of reception, but rather the general level of intensity of the background of atmospheric and electrical disturbances. All of the vast engineering and amateur effort to make more sensitive sets can henceforth be considered as being spent for the benefit of those radio listeners who desire to hear distant stations, with interruptions, rather than for the listeners who desire to hear only the radio programs that come through without extraneous disturbance.

The most conspicuous recent development in radio engineering is the conquest of the new domain of ultra-radio or very high frequencies (short waves). Even the existence of the vast range of frequencies above 2,000 kilocycles (below 150 meters) was hardly suspected, and certainly was generally forgotten, up until less than a year ago. One curious reason for the subordination of this range of frequencies has been the erroneous use of wave lengths in meters as an expression of radio frequencies. Radio engineering actually deals with currents which have a certain frequency. The wave length of the wave as it travels along in space can be calculated from the frequency, but it is a derived and an artificial concept. It is unfortunate that it was introduced in the early history of radio and came to be used more extensively than the concept of frequency. The usual unit of frequency used in radio is the kilocycle (1,000 cycles per second). Frequency in kilocycles is equal to 300,000 divided by wave length in meters, and, vice versa, wave length in meters in 300,000 divided by frequency in kilocycles. Between 150 and zero meters, there seems to be only a small territory, but expressing the same fact in terms of kilocycles it at once appears that there is an infinite territory above 2,000 kilocycles.

At the Second National Radio Conference held in March, 1923, the frequencies above 2,000 kilocycles were entirely neglected since no radio communication to speak of was carried on above that limit. Now, however, frequencies up to 20,000 kilocycles have come into extensive use. By their aid speech has been transmitted to the antipodes on 3,300 kilocycles; we may say that a demonstration has been given of the ultimate goal of radio. Actual radio services are being conducted in this region by broadcasters, transoceanic communication companies, military services, amateurs; in short, every important radio interest has begun operations between 2,000 and 20,000 kilocycles. Even higher frequencies have been used in experiments, but there is every likelihood that in the development of frequencies above 20,000 kilocycles directive transmission will predominate and the problems will be of a distinctly different character.

In the exploitation of the high frequencies the radio world finds itself in the position of a person who has fallen heir to a rich legacy, for there is now available for actual use a region roughly twice as great as radio had at its disposal a year ago. Calculated on the basis of channels ten kilocycles wide the gain appears far greater than this, since between 2,000 and 20,000 kilocycles there are 1,800 such channels, as compared with only 200 such channels in the older region below 2,000 kilocycles. It will, however, probably be a long time before full advantage can be taken of the channels thus theoretically available. Assuming that at present, receiving sets can satisfactorily receive stations situated at equal distances having a frequency separation of two per cent, there are only 116 channels immediately available as against the 1,800 channels theoretically and eventually available.

So important are these high frequencies now, the Third National Radio Conference, held in October, 1924, parceled out the high-frequency territory among the various radio services, thus reaching a solution of a problem which only a year ago was regarded as insoluble, that of finding more communication channels. Alternate frequency bands ten per cent wide were assigned to the following different services: land point-to-point, aircraft, ship, relay, relay broadcasting, public service, amateur and army mobile. An important principle was followed in this assignment: viz., each service was protected from possible harmonic interference from stations of other services by placing the several frequency bands of any given service on its own harmonics.

What are the reasons underlying this revolution in the use of the higher frequencies? One reason is that the waves of very high frequency behave differently and carry to much greater distances than the behavior of the lower frequency waves would lead us to expect. To understand this better it is necessary to consider the law of radio wave transmission. The principal facts are expressed by the formula

$$H = \frac{I f}{d}$$

Where H is a quanity proportional to the field intensity of the radio wave. I is the transmitting antenna current, f the frequency and d the distance. According to this it would be expected that a more intense field, a stronger wave, would be produced at a given distance the higher the frequency; in other words, that high frequencies would be better than low frequencies. However, it was found in the early days of radio that this formula does not represent all the facts. As a radio wave travels on, part of its power is absorbed by the earth or other obstacles, and in order to take account of this absorption it is necessary to divide the right-hand member of the above formula by the factor $k \sqrt{f d}$. The higher the frequency the greater does this absorption factor become and the smaller the received wave intensity. Moreover, since the frequency enters as an expotential, the absorption becomes extremely great for high frequencies and long distances. It

has therefore come to be accepted in radio engineering that for long distance communication it is necessary to use the low frequencies, and the commercial transoceanic stations in fact use the very lowest radio frequencies or longest waves. All this has represented the facts very well for daytime transmission.

For nighttime transmission, however, the matter is more complicated, and becomes very interesting. When using frequencies of the order of 1,000 to 2,000 kilocycles, it has been very commonly observed that the waves carried much greater distances at night but in an irregular way, being accompanied by fading. It appeared that some influence was at work at night which caused the transmission distance to vary from instant to instant, between the distance that would be calculated on the basis of the usual absorption factor and a limit determined by complete disappearance of the absorption factor. Recent work with the still higher frequencies, above 2,000 kilocycles (below 150 meters), indicates that at these frequencies the absorption factor is still more likely to be absent or not effective. In other words, at the very high frequencies the real superiority that would be expected from high frequencies on the basis of the simple formula first stated above is actually realized, and the absorption phenomena which limit the distance of transmission at the lower frequencies are non-existent or less in magnitude.

An explanation of these peculiarities of wave transmission at various frequencies may be given as follows: There is in the upper atmosphere at a height which has been roughly estimated at about sixty miles, a level at which the very rare atmosphere is practically all ionized, and above which it can be concluded as a permanent conductor. The phenomenon of aurora has its seat above this level. This level is called the Heaviside surface or the Kennelly-Heaviside surface. In the daytime the air between this surface and the earth is heavily ionized by the sun's rays, and radio waves can not penetrate very high into it. The waves travel in the daytime, therefore, along the ground, and are subject to absorption by the more or less imperfect conducting objects and materials along which they travel. As previously explained, this absorbing effect is greater for the higher frequencies and therefore in order to cover great distances the lower frequency waves must be used. At night, however, the waves are free to traverse the upper air and reach the Heaviside surface and travel along it. The higher frequency waves reach great distances because they are not subject to the absorption experienced at the surface of the earth, and therefore actually have the advantage which theoretically the high frequencies should have. The transmitted waves, however, are subject to more or less variation because the Heaviside surface is presumably not strictly smooth but is rough or wavy and has large shifting masses of more or less ionized air in and near it. These variations account for fading. If the dimensions of the irregularities or masses at or near the Heaviside surface be assumed to be in the neighborhood of 200 meters, they would produce no effect on the longer waves but would irregularly absorb the waves around 200 meters and cause variations in received signal strengths.

To explain the behavior of the waves shorter than this, it may be assumed that these shorter waves find their way in and out among the obstacles and masses associated with the Heaviside surface and are not broken up by them in the way that the waves around 200 meters are. It would therefore be expected that these very short waves would be subject to less fading and go greater distances, and this is found to be the case. There is some evidence that these very short waves travel better in the daytime than do the somewhat longer waves. This can only mean that they find the way somehow without much absorption in the space between the earth's surface and the more heavily ionized upper parts of the atmosphere. It must not be thought that they travel as well by day as by night; it has in fact been found that for a long path of travel the absorption is pro-

portional to the average altitude of the sun over the whole path. This whole explanation involving the upper atmosphere is, of course, only a hypothesis, and other explanations based entirely on electrical conditions at or near the earth's surface are conceivable and have been advanced.

In addition to the great distances of transmission, an advantage of the higher frequencies is that the transmitting antenna and station operate at high efficiency. With a relatively short vertical antenna it is easy to have a radiation resistance which is the greater part of the total resistance, a condition which is very far from true with lower frequencies. This means that the greater part of the power fed into the antenna is actually radiated instead of lost in heat. The apparatus for a short-wave transmitting station is relatively simple and cheap. The antenna coils and other parts are smaller and work at lower frequencies. Another great advantage is that atmospheric disturbances are very much less noticeable than in lower frequency transmission.

The disadvantages of the high frequencies are few. One of these is that automobile ignition systems emit waves of the order of 10,000 kilocycles and higher frequencies, thus giving a troublesome source of interference. Another disadvantage is that the waves are so short that many objects about a building or laboratory have natural frequencies in the range used, and it is difficult to make measurements and be sure that spurious effects are not introduced by radiation or absorption of power from such objects. Even measuring instruments and their component parts have such natural frequencies and introduce errors which must be carefully guarded against. Similarly in short-wave transmitting apparatus the generators used to supply direct current and other devices may readily produce a high frequency which is troublesome because it may carry with it a low-frequency modulation due to a commutator or other source which may introduce a ripple in the transmitted signal. It has been suggested to the author that there may be resonances affecting short-wave transmissions even from the sands on the seashore, inasmuch as ordinary sand has the property of piezo-electricity, and that this may have an influence in fading and dead spots. Piezo-electricity is an important property, applications of which will be mentioned later. Suffice it to say here that there doubtless is an actual response to radio waves of a very high frequency by every grain of silica sand.

Great progress is being made just now in perfecting methods of confining radio transmission to a desired direction. The methods used go back in principle to the first suggestion which was made along this line. This original plan contemplated the use of two vertical antennas one-half wave length apart with currents in opposite direction, that is 180° different in phase, in the two antennas. The phase difference of 180° between the radiation from the two is just compensated by the half wave length of distance between them, as far as radiation along the line joining them is concerned. Along this line, therefore, their effects add together. On the other hand, for a point on a line at right angles to the line joining them, there is no such difference of distance and the radiation from one exactly neutralizes that from the other.

More actual use has been made of another method of directive transmission which is apparently very different but is in a sense the same in principle, namely, the loop or coil antenna. If a large loop antenna is used as a transmitting antenna, on account of the fact that the current is in opposite directions in the two vertical sides there is theoretically no transmission in a direction at right angles to the plane of the loop antenna and a certain maximum of transmission in a direction in the plane of the antenna. Since the distance between the two vertical sides is usually considerably less than a half wave length, such an antenna is not a powerful transmitter. Its value as a directive transmitter is furthermore limited because the capacity of the whole structure to ground acts as an ordinary non-directive antenna.

A third method which has come into use is applicable only to very high frequencies or short waves. It involves the use of a parabolic reflector placed behind the vertical transmitting antenna. The method is only practical when the wave length is so short that a reflecting structure is not unwieldy. In order to be effective the reflector must be an appreciable part of a wave length. None of these methods give anything approaching a strictly narrow beam of transmission analogous to a searchlight used for projecting a light bean. They merely give a transmission in one direction which may be several times the intensity of transmission at right angles to that direction.

A fourth method is now being developed by Marconi in England and by American companies, which seems to offer much greater promise. It is an extension of the original scheme for directive transmission. It is essentially the use of a large number of transmitting antennas and carefully regulating the phases of the currents in them, to give any desired directive effect. One form of this method, commonly called the beam system, uses a straight row of vertical antennas placed close to one another. By means of special generating apparatus, current of identical magnitude and phase is supplied to each of these antennas. Such a system transmits more in a direction perpendicular to the line of antennas than along the line. This may be seen as follows: Suppose the line is one wave length long. Then radiation from two antennas A and A^1 spaced a half wave length apart will give zero effect in the line of the row of antennas, because such radiation from the two antennas A and A^1 would be 180° different in phase because of the half wave length separation between them. At a point perpendicular to this line, however, the distance from the two antennas would be equal and the effects would be additive. For every antenna in the row there is another one separated from it by a distance of one-half wave length. If the row is made several wave lengths long, the sharpness of the beam of waves transmitted becomes very great, that is, there is a large ratio of power transmitted in the desired direction to that at right angles. This ratio may be several hundred. It is theoretically applicable to any frequency but is, of course, most convenient when the wave length is sufficiently short so that the row of antennas does not have to be inordinately long.

This system is further improved by placing parallel to the row of antennas a similar row one-fourth wave length away. Identical current is fed to all of these antennas at a difference in phase of 90° from that in the first row. For transmission in one direction the 90° phase difference will be neutralized by the one-fourth wave length separation, and the radiations of the two systems will be additive, while in the opposite direction the two will cancel each other and thus the system is made strictly uni-directive rather than bi-directive, sending out something approaching a true beam in a single direction. The same type of system may also be used for receiving, effecting a great gain at the receiving end also. The British Marconi Company carries on commercial communication between Poldhu and Buenos Aires, a distance of 5,800 miles, with this system.

In general, directive transmission is accomplished by using a number of transmitting antennas and so adjusting the phases of the current in each, in relation to their distances apart, that reenforcement of radiation is obtained in one direction and more or less neutralization of radiation in other directions. An obvious advantage of beam transmission is that much lower power is required than in ordinary radio transmission, since the transmitting power is all utilized in sending the waves in the desired direction instead of all directions. This important advantage, which means reduced cost, will probably not be fully realized because the great ratio of transmission in the desired to undesired directions is probably reduced as the wave spreads out to great distances. The undoubtedly great directivity for relatively short distances from the transmitting station, however, offers highly im-

portant advantages in another particular, the reduction of interference caused by the transmitting station.

A radically different development which can be considered as, in a sense, a method of directive radio transmission, is automatic radio relaying. For several years there has gradually developed a method of automatic relaying of radio telegraphy and telephony, the incoming signal being used to operate a transmitting set on a different frequency. Methods are now available to do this on the same frequency. There are various methods by which this is possible; one is a sort of barrage reception, the antenna arrangements being such that the antenna which does the receiving is protected against the radiation from the antenna which does the transmitting. By using any one of a number of such automatic relaying stations it is possible to send a radio transmission along the line of such relay stations and arrive at a distant point with far greater signal intensity than at any equal distances in other directions from the original transmitting station. Such a system is actually being used as one method of relaying broadcast programs from one broadcasting station to another. The method is like a long-distance telephone line with its amplifier or booster stations but with the wire line eliminated. Quite possibly such a method will be used in conjunction with the beam system of transmission, thus giving an extremely economical and non-interfering system.

One of the principal means of overcoming interference between the transmissions from simultaneously operating radio stations is obviously the increase of selectivity or narrowing of the band of frequency which each station uses. Progress in this direction is being made in all the various types of transmission, as for example through the use of filtering devices for radio telephony and coupled circuits and spark apparatus. The principal advance,, however is the increasing adoption of continuous-wave transmission for radio telegraphy. In continous-wave, that is, unmodulated transmission, the wave sent out need depart from a pure sine wave only through the variations imposed by the keying, that is, the production of dots and dashes. Even for very high-speed keying this departure from the sine wave and broadening of the wave is very slight. So far as radio telegraphy is concerned, continous waves furnish a very satisfactory means of securing selectivity at the transmitting end. This makes it possible or worth while to use highly selective apparatus at the receiving end. In order to take full advantage of this system it is necessary that the frequency of transmission be kept quite constant, and where a great many communications must be carried on simultaneously it is also necessary that these frequencies be set accurately to a predetermined value.

We have thus the advent of strictly constant frequency systems. A striking means of accomplishing this is furnished by the piezo-electric oscillator. Certain crystal substances, such as quartz, have the property of piezo-electricity, that is, when a piece of the substance is mechanically strained a voltage is produced between its ends, and vice versa, when a voltage is impressed a slight deformation of the body takes place. It follows that when a piece of piezo-electric crystal is caused to vibrate there is produced between its ends an alternating voltage, and vice versa, impressing an alternating voltage upon such crystal causes it to vibrate mechanically. Maximum vibration is obtained when this alternating current has the same frequently as the natural frequency of mechanical vibration of the crystal. By associating such a crystal with an electron tube, it is possible to generate current whose frequency is determined solely by the frequency of mechanical vibration of a crystal. The frequencies thus produced are, happily, in the radio range. Current thus produced by the piezo-electric oscillator can be amplified and supplied to a transmitting antenna. At the receiving end, apparatus must be used to insure response at exactly the right frequency, and here enters the question of frequency standards. This question, and the usefulness of piezo-electric crystals therein, will be mentioned again. A new

radio communication system of the utmost selectivity and precision is made available by this new device, and services which require the operation of a large number of transmitting stations spaced as closely together as possible in frequency and taking full advantage of C W transmission will find this a great improvement.

There is increasing progress in knowledge of the factors entering into radio interference and methods of eliminating various types of interference. As it affects broadcasting, some information of this kind is available as a result of a program of observations carried on by the Bureau of Standards during the past two years with the cooperation of about 200 voluntary observers, located from zero to 400 miles from two selected broadcasting stations. Preliminary results show the following averages for all observers: first, no interference, twenty-three per cent of the time when reception was attempted; interference from other broadcast stations, thirty-two per cent; atmospheric disturbances, eighteen per cent; fading, i.e. irregular variation of intensity of received signals, thirteen per cent; amateur transmitting stations, six per cent; radiating receiving sets, five per cent; commercial radio telegraph stations, two per cent; non-radio electrical interference, one per cent. More complete and final results will show decreases in the percentages for the several causes of interference which are under the control of man, and corresponding increases in the percentages for the natural interference from atmospheric disturbances and fading. The man-made interference of the various types is of local character, some types of it being confined to very small areas around the source of disturbance.

Considering the least of these causes of interference first, steady diminution of non-radio electrical interference is in progress. There are, it is true, frequent complaints of disturbances from a large variety of electrical causes, including 60-cycle power line induction, sparking commutators, X-ray apparatus, arc lights, faulty insulators, electrical precipitators, and many electrical devices used in homes and in industry. Some of these cases involve faulty operation of the electrical devices, and much valuable work has been done by the electric power companies and others through the use of portable receiving sets, direction finders, etc., in tracing down the cause of the disturbance. It should be pointed out, however, that there are some electrical devices which even when in perfect working order cause interference with radio reception. In many cases it is possible to provide shields, shunting condensers, chokes, or filters at the source of interference or at the receiving set which relieve the difficulty. There remains a part of such interference, however, which is practically inevitable and which must be regarded like atmospheric disturbances as part of the inherent limitation of radio reception. As previously pointed out the omnipresent background of slight electrical disturbances which drown out signals below a certain intensity cannot be overcome by increasing the sensitivity of radio receiving apparatus, and sets a definite limit on the possibility of satisfactory reception from far distant stations.

Interference from radiating receiving sets is being reduced as a result of a number of influences. As a matter of fact the winter of two years ago when all broadcasting stations were on the same frequency is included in the time covered for the figure above given of five percent of the total interference. The prevalence of such interference was unquestionable greatly reduced by the placing of broadcasting stations on separate frequencies. The recent trend of manufacture and sales of radio apparatus have been to limit use of radiating sets to rural districts. This effort is being supplemented by a campaign of education in the operation of regenerative and superheterodyne sets. As a result, interference of this type is now largely confined to congested city districts, particularly in apartments and row houses, in the reception of distant stations. There is relatively little interference from this cause with reception from local stations. Technical de-

velopment of receiving sets will doubtless continue to reduce this type of annoyance.

Interference from radio telegraphy as distinct from radio telephony is decreasing. This includes amateur and commercial station interference. The improvement is coming about through the keeping of each service more definitely within distinct frequency bands, through closer adjustment of individual station frequencies, and through apparatus improvements, such as coupled circuits, which sharpen the wave emitted. There are three radically different categories of successively decreasing width of wave (formerly expressed in terms of decrement); viz., damped waves, phone, and continuous waves. It is increasingly recognized that the interference produced by damped waves is out of all proportion to the requirements of modern radio communication. Spark transmitting apparatus has been largely eliminated except for ship use. When it is finally eliminated on ships as well as elsewhere, radio will enter on a new stage of perfection.

Since the principal interference to broadcast reception comes from other broadcasting stations, an improvement in this situation is of first importance. Several developments indicate that this improvement is at hand. One thing that should help is the increase of the frequency band for broadcasting provided by the Third National Radio Conference (sixty-three independent channels for the higher class stations as against thirty-nine heretofore). Another trend that is helping to solve the problem of broadcast station interference is the increasing realization that the local stations give better quality and more satisfactory service than the distant stations. While the thrill of reception from very great distances continues, there is a constantly growing demand for reliability and perfection of quality in the received programs which is not obtainable from the distant stations.

The reason why the local stations give technically superior quality and satisfactory reception is simply because they deliver a radio wave to the receiving antenna of an intensity greater than that of the prevailing atmospheric and electrical disturbances. In order to deliver a signal of the same intensity to a larger number of people or a larger territory it is necessary to use higher power in the transmitting station. Hence there will be increases in the power of many of the stations from now on. Considerable fear has been expressed that the use of high power, while of obvious benefit to the farmers and others remote from the stations, would make it harder for city dwellers to tune out the nearest station when they wished to receive others. This fear will not be realized at all if the simple rule adopted by the Conference is followed, of locating stations of higher and higher power farther and farther away from centers of population; in fact, reception conditions will be better for the city dwellers than in the present situation which has the principal stations located in the very midst of the cities.

The past year has witnessed notable progress in the keeping of transmitting stations on their assigned frequencies. In particular, the assignment of separate frequencies to broadcasting stations at the end of 1923 assumed a precision of frequency regulation of the individual stations greatly in excess of the precision previously attained anywhere. The frequency separation of ten kilocycles between broadcasting stations meant as close as one per cent separation and in order that each station operate in its own channel an accuracy of frequency adjustment very much better than one per cent was necessary. Prior to 1924, not only did stations in general depart many per cent from their assigned frequencies, but even the wavemeters used as standards for frequency measurement and control by various laboratories and authorities throughout the country, likewise differed among themselves by a good many per cent.

Improvements in the accuracy of frequency measurement were necessary in order to carry out the definite and precise station frequency assignments in all the various classes of radio service. This has necessitated intensive study, particularly by the Bureau of Standards, in the improvement of the

accuracy of frequency measurements and standards. This work has included the improvement of standards, the increase of constancy and precision of wavemeters, improved methods of absolute frequency measurement, and the adaptation of piezo-electric resonators and oscillators as frequency standards. The work on frequency standards is so promising that there is now foreshadowed radio operation on frequencies so constant that variations of phase rather than intensity or frequency of the current will produce signals. A new tool, phase variation, will thus be in the hands of radio engineers, with the possibility of important applications to secret, directive, and high-speed signalling.

The improved frequency standards are made freely available through the transmission of special radio signals of standard frequency from 125 to 6,000 kilocycles. These are transmitted from Washington, D. C., and from Stanford University, California, once every two weeks. Similar signals of standard frequency are transmitted in France and England. As an aid in the maintenance of constant station frequencies, many of the broadcasting stations are using specially constructed wavemeters known as frequency indicators or one-point wavemeters. The importance of using a device of this kind to assist in maintaining the frequency constant is emphasized by complaints which are received by the department from time to time of interference between various broadcasting stations. For example, a listener in Baltimore recently reported interference between two broadcasting stations, one of which was located in Cincinnati, and one in California, this interference arising because one of these stations was off its assigned frequency by only one-half per cent. Obviously, frequencies must be maintained to a higher accuracy than this in order to make such interference impossible.

The constancy of frequency of some stations is so good that it is possible for the Bureau of Standards to publish each month a list of stations which have been found by measurement to maintain high constancy. The transmissions from these stations thus become available to the public as frequency standards. Since the stations are in operation every day they are particularly valuable and freely available standards of frequency. The experience of the past year on this subject of frequency control proves that proper frequency assignment, supplemented in practice by the actual operation of stations very closely on the assigned frequencies, is a most important element in the reduction of interference.

Concluding this discussion of the various causes of interference, it may be said that they divide into two great classes, natural and man-made. Progress is being steadily made against both of these enemies. As to the natural interference, there will always be a certain residuum of atmospheric disturbances and fading which will necessarily limit the distance from any broadcasting station at which reliable satisfactory reception will be possible. The various kinds of man-made interference, on the other hand, are curable and are of local character; it can be expected that more and more localities will be freed from the various types of this pest.

It has not been possible even to sketch herein all the ways in which important progress is being made upon radio engineering problems. I have not touched upon many interesting phases of radio which are applications of engineering rather than engineering itself. Increase of knowledge and of practical applications characterize all phases of radio. We are coming to have a picture of the machinery by which the waves are propagated. Remarkable discoveries are being made in the behavior and potentialities of the waves of hitherto unknown frequencies. We are learning to direct the waves in a desired direction. The battle against interference is being won in spite of enormous increase in the use of radio. In all of these and its other phases radio engineering is a fascinating subject, and one perhaps unique in the character and rapidity of current progress.

MISCELLANEOUS

Psychological Tests

United States Infantry Journal, March, 1925.—First Lieutenant Carl C. Brigham,* A. G., O. R. C.—There is no definite, certain, or fool-proof method of selecting commissioned personnel, nor of selecting individuals for admission to college, nor for any other specified job. The problems involved in the measurement of intelligence, in the estimation of character traits, and in the evaluation of the individual's past experience are too complex, and the advances made toward the solution of the questions of measurement involved too tentative to warrant any cocksureness or certainty of judgment.

The following analogy gives a true picture of the situation. We are asked to measure the height of a thousand recruits, but we are not allowed to use a stadiometer, nor to take vertical linear measurements of any sort. Under these conditions we very obviously can not *measure* height, but we might conceivably work up a fairly good guessing system. When one thinks of the relationship between height and weight, for instance, one immediately thinks of the short, slender fellow and the short fat man, or the cadaverous six-footer and the circus strong-man of the same height. Yet there is a positive relationship between height and weight, and if one consistently picks heavier men, he will, in the long run, pick taller ones.

The person assigned the problem of measuring the height of a thousand individuals without taking vertical linear measurements might allow us a few measurements in the horizontal plane, such as the circumference of the chest and the waist-band, and to collect miscellaneous data such as the size of the shoe, of the hat, and numerous other things. He might also let us try all of these measurements on another group of known height, before we tried to measure his thousand recruits. If we were allowed to do this, we would know the exact relation of each of our measures to height, and to each other, and we could, by cut and fit methods, devise a fairly good scheme for predicting or guessing height, when weight and five or six measures in the horizontal plane were known.

This is similar to what we do in selecting persons for commissions. The unknown, or height, is the future military value of the person. We make subjective judgments of his physical appearance, his ability to command, his tact, and innumerable other traits. We have his medical examination, his record of achievement in civil life, and from all these variables, we estimate his probable success as an officer. This estimate is in no sense a measurement, but merely a method of guessing or betting. The greater the number of different traits independently estimated or measured the better the betting.

Statistical method comes to our aid in a problem of this sort by evaluating the better systems which might be evolved. The method is known as that of correlation. Given a group of individuals in which the desired trait—ability as an officer—is definitely known, and any number of estimates of character traits, and other more exact estimates or measurements, the statistician, using the method of correlation, can find the best method of combining these various, diverse appraisals to get the maximum prediction of the desired trait. The system so devised may then be tried on new applicants, while further experimenting is being carried on. In this way, methods of selection may be improved experimentally without altering existing methods, until innovations have justified themselves by actual trial.

Intelligence tests have been very greatly improved since the war, and at Princeton University a considerable amount of work has been done in developing tests for the higher levels of intelligence such as one finds in a college population selected as carefully as this. It occurred to the writer that it might be worth while to compare standing in the courses in military

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science with other measures of attainment. The following measures were available for eighty-two men who had completed two years of the R.O.T.C. training:

a. The weighted average of the content examinations of the college entrance examination board given for entrance to Princeton;
b. The records of two intelligence tests each lasting three hours and given with an interval of a year between tests;
c. The academic marks in eight courses of a year in length, or of sixteen term marks in all;
d. The marks awarded in four terms of work in military science.

The first step in analyzing the data was that of determining the reliability of the four grades in military science. Very obviously, these four marks would not be a final nor ultimate criterion of later success as an officer, but they must have something to do with it. The upshot of the study of these marks was that they were rather unreliable, as they did not correlate with each other very highly. On the other hand, they were four measures of the same thing, made from different angles, and we took the sum of the four grades for what it was worth.

The next step was the analysis of the relationship between grades in military science and grades in the other sixteen half courses. If any of the men had been ill, or devoting too much time to extra-curricular activities, and so forth, the chances were that fluctuations in standing caused by such factors would operate synchronously in military science, so that the correlation between the R.O.T.C. grades and the other sixteen half courses might be taken as the possible high water mark of correspondence or mutual implication. This value was determined as being .72 on a scale running from 0 to 1.00 expressing the degree of correlation. Such a value is fairly high in the field of educational measurements.

The next step was the comparison of the other two measures which might be used for predicting standing with the grades in military science. The correlation between the average of the subject-matter examinations of the college entrance examinations board with the average of the grades in military science was .35 or about half of the maximum prediction. The correlation of one psychological test with the grades in military science was .45 or about three-fifths of the maximum prediction. The correlation of the other psychological tests made at the time of entrance was .58 or about five-sixths of the maximum prediction.

Another interpretation of the results may be made using the intercorrelations of the four courses in military science as the basis. The highest correlation between any single term in military science and any other term in military science was .61, so that it is seen that the better of the two psychological tests will predict the average standing in four terms of military science just as highly as one term predicts another. The most conservative interpretation that the writer can make of the results, taking into consideration the intrinsic unreliabilities of all measures involved, is that the psychological tests taken together give about seven-ninths of the maximum possible prediction.

The writer does not regard these results as particularly striking, but considers that they offer a promising lead for further investigation. Experimentation with different types of measures demands a rating of efficiency to check against that is as reliable and as stable as it is possible to secure. Such a rating or grading system exists at the Military Academy at West Point. It was therefore suggested that the experiment with psychological tests be continued at the Military Academy, all possible tests and measures being given very early in the candidate's West Point career, and the results studied at the end of four years, when definite information would be available concerning each candidate. In this way, tests which were not diagnogstic of military success could be eliminated, and a collection of diagnostic

tests made and stored away against another national emergency, or for purposes of an additional check on the selection of candidates for the Military Academy itself.

Intelligence tests should never be used as the sole criterion for judging a candidate, nor as a method of rating officers concerning whom more definite evidence of a tangible sort is already available in their military record, nor as a substitute for existing methods of selection, but as a supplement to existing methods. During the war, they proved their value as an aid in the quick and effective sorting of recruits. The development of methods of testing since the war should be capitalized for improving the selection of commissioned personnel, as an aid in the inevitably hurried assignment of commissioned personnel to specific jobs, and for whatever purposes they may be experimentally demonstrated as serviceable during peace time.

The use of intelligence tests alone will not give an absolutely valid method of selection, but, when used in combination with other measures, should improve the accuracy of the guesses as to future success. The technique of their use is exactly that described in the analogy given of trying to predict height from weight and other measurements.

It has been objected that this thing the psychologists call "intelligence" is a useless trait to measure when the final concrete situation under fire involves the moral qualities and emotional stability more than mental alertness. The answer to this objection is that intelligence measurements should not be substituted for estimates of the other traits, but made in addition to them, and that mental alertness is a decided asset in the handling of any military situation. Popularity, military fitness consists in exemplary behavior in the over-the-top situation, but basically it is a much broader ability than that.

Like other college professors, the present writer might be characterized as being utterly impractical and visionary, but he wishes to close with a reflection on the peace-time composition of the Army for the amusement of his readers in the service. He ventures to make the assertion that the best interests of the country demand the very highest possible type of commissioned personnel during times of peace. The main function of the Army in peace is not only that of keeping existing machinery oiled and running, but of inventing new methods of warfare, and anticipating possible developments. The peace-time personnel should, therefore, include the very highest types of creative genius that the country possesses.

CURRENT NAVAL AND PROFESSIONAL PAPERS

"Ship's Motor-lifeboat with Wireless Equipment," *The Engineer,* February 6, 1925.

"Castings for Diesel Engines," *The Marine Engineer and Motorship Builder,* February, 1925.

"Old Military Customs Still Extant," *Journal of the Royal United Service Institution,* February, 1925.

"The Ford Electric Torsionmeter," *Engineering,* February 13, 1925.

"The Propulsion of Ships by Oil Engines with Hydraulic Mechanical Reduction Gearing," *The Shipbuilder,* March, 1925.

"The Trend of Development of Marine Propelling Machinery," *The Marine Engineer and Motorship Builder,* February, 1925, *et seq.*

"An Economic Basis for Sizes," Bulletin of American Engineering standards Committee.

NOTE: Single copies of the above articles are on file at the Institute office and will be loaned to members upon request.

NOTES ON INTERNATIONAL AFFAIRS

FROM FEBRUARY 23 TO MARCH 23

PREPARED BY

ALLAN WESTCOTT, PROFESSOR, U. S. NAVAL ACADEMY

GERMANY AND THE ALLIED POWERS

FOCH ON GERMAN ARMAMENT.—On March 3 Marshal Foch as chairman of the Interallied Military Commission presented to the Conference of Ambassadors an interpretation of the long report of the special commission on German armament. Marshal Foch did not enter into technical details, but pointed out that the German Reichwehr consisted entirely of former commissioned and non-commissioned officers, who are being trained to command troops and would furnish a framework for an army of 500,000 or 600,000; that the "Green Police" were in effect a military organization and that there were many secret semi-military societies in Germany; and that the German general staff consisted of 250 officers, or only sixty less than for the Kaiser's pre-war army. Marshal Foch's aim was to show that mere insistence on technical fulfilment of treaty terms would gain little, and that the security of France and her former allies must be provided for by other means. The Conference, however, called for specific technical recommendations, thus reflecting the British policy of keeping the question of treaty fulfilment separate from the larger security issue. The only technical requirement to which the French are now said to attach much importance is the neutralized Rhine frontier.

BRITISH REJECT GENEVA PROTOCOL.—At the session of the League of Nations Council at Geneva beginning March 9 the British Foreign Minister, Austen Chamberlain, made an extended statement setting forth his government's reasons for declining to ratify the Geneva Peace Protocol, and for preferring instead a system of mutual guarantees among groups of nations. At bottom the British objection appeared to be based on unwillingness to accept arbitration of all international issues, preferring, like the United States, to reserve the right to say what issues are or are not justiciable. The Canadian representative in a separate statement supported the British position, citing among other objections the effect of non-participation by the United States upon attempts to enforce sanctions. In proposing mutual guarantee treaties among groups of nations as a substitute for the protocol, the Baldwin government returned to the plan of military alliances rejected by the Labor Government eight months ago.

The Council adopted a resolution sending the protocol back to the Assembly, and leaving little prospect of immediate solution of the security problem. In the discussion in the Council, the smaller nations, whose chief spokesman was Foreign Minister Benes of Czecho-Slovakia, strongly supported the protocol, which appeared to them the only effective means of assuring a peaceful settlement of the many problems of central Europe.

SEES HOPE IN BRITISH PROPOSALS.—From *The New York Times*, 14 March, 1925.—Professor James T. Shotwell of Columbia, co-author of the American proposal which formed the basis of the Geneva protocol to end war, declared today in commenting on Austen Chamberlain's attack yesterday on the protocol:

"The British Government rejects the protocol of last September but, at the same time, it offers suggestions of a line of policy which would make possible some sort of substitute for the plans of the League. In the first news items it was natural that the negative aspect of this action should receive most emphasis, but it is the positive side of the actual British proposals which really demands our attention most.

"The first question is whether the British proposals are simply vague phrases intended to soften the blow to the feelings of France and those nations which supported the proctocol. In that case there would be nothing left but the polite camouflage of diplomacy. The total effect of the action of Britain would simply be a return to the old balance of power theory with the inevitable race in armaments and the almost equally inevitable catastrophe at the close.

"It is inconceivable that this cynical interpretation should stand. There is no reason to question the sincerity of the positive proposal any more than the motives which underlay the formation of the proctocol itself. Great Britain has not spoken at Geneva with the repressive and disheartening message of unregenerate militarism, but with a desire to contribute toward a different method of solution than that pursued in the formation of the protocol.

"Britain proposes, in substance, that there should be a development of pacts of non-aggression between potential enemies, agreements of limited extent and obligation by which specific differences shall be settled peaceably and both parties to these pacts agree upon some workable measures for limiting their armaments. There is in this plan the elements of an enlarged adaptation and, therefore, a justification of the Washington conference method."

RENEWED TALK OF NAVAL CONFERENCE.—With the rejection of the Geneva protocol and abandonment of a general disarmament conference under the League, attention was again directed to the possibilities of such a conference under American auspices. President Coolidge had indicated his intention, in case of failure of the League plans, to sound the powers who participated in the Washington Conference as to their attitude regarding a second meeting. It was made clear in Washington that at this second conference only discussion of naval reduction was contemplated.

THE PROBLEM OF SECURITY

FRANCO-BRITISH NEGOTIATIONS.—A Paris dispatch of March 21 stated that the British government, in discussing a security agreement with France, insisted that the inclusion of Germany should be considered. The British

position was that Germany should be given an opportunity to state the terms upon which she would enter such a pact. If the objections in the way of Franco-British agreement should be removed, a conference of the four powers—France, Belgium, Great Britain and Germany—might be held in the coming summer.

Edwin L. James in *New York Times*, March 6.—An eloquent commentary on the complexity of European affairs is that with France desiring English protection against Germany and with England's Government ready in principle to give that, the matter cannot be dealt with expeditiously. France wishes to have the English guarantee and at the same time keep her alliances on the Continent. In that the English see grave danger of committing themselves too far. England is willing to promise to protect France against a German invasion in order to protect the Channel ports, but at the same time Downing Street has other auxiliary motives. In a three-cornered treaty of England, France and Germany, England would always be the deciding factor between France and Germany, or at least that is the calculation apparently made. At the same time England wishes to keep Germany and Russia separate, and therefore listens attentively to a German proposal to come in, only biding her time to impose as a condition the tearing up of the Rapallo Treaty between Berlin and Moscow.

There is no doubt some British statesmen would shed no tears over the end of France's system of alliances on the Continent. But having spent four years, much effort and money on building up her system, having hard and fast formal alliances, the French are not yet ready to drop all that for a security treaty bearing Germany's signature.

The situation is about as complicated as it could be, and no one just now knows the answer. The French have probably got a hard decision to make, and certainly the mind of Paris is not made up. In the circumstances, England holds the center of the stage. It will be when England offers France her promise of protection in a security pact including Germany that the French attitude will be all important. Nationalist France is dead against the German proposal. The Left is by no means unanimous for it.

Opposed to a League of Europe.—Rome, March 21.—Signor Schanzer, former Italian Foreign Minister, who has had a prominent part in League of Nations affairs, has contributed a leading article to the *Giornale D'Italia*, arguing against the formation of "a United States of Europe in a supergovernmental sense."

The article was written because of the discussion which has been aroused over the plan for regional pacts, introduced by Dr. Benes, Czecho-Slovak Foreign Minister, at the recent session of the League of Nations Council.

Signor Schanzer declares that such unions as suggested by Dr. Benes are likely to stimulate a pan-Oriental movement, signs of which, he asserts, are appearing in the rapprochements between Japan, China and Russia. They would also tend to orientate the British Empire and American power, thus, in the opinion of Signor Schanzer, ultimately developing a balance of power system over the whole world, similar to but many times greater than that which existed before the war.

"Therefore," Signor Schanzer says, "it would be fraught with much more deadly consequences."

The best plan, Signor Schanzer believes, would be to have a security and peace pact among the leading European nations, including Germany, into which other nations might enter whenever they chose.

GERMANY

Germany Invited to Enter League.—In a private session the League Council on March 10 rejected German's conditions regarding entrance into

the League of Nations. The Council, however, decided that a reply should be sent to Germany which, while refusing to exempt her from military duties called for by the Covenant, should express a cordial desire for German's entrance into the League, and give assurance that Germany would be accorded a seat on the League Council, as evidently intended in the Covenant.

ELECTION OF PRESIDENT TO SUCCEED EBERT.—President Ebert of Germany died of peritonitis at the end of February and was buried at Heidelberg on March 5. The German constitution provides that in the election of president a candidate to be elected must receive more than half of the total vote cast; if no candidate receives such a majority, a second election is held, in which the candidate who receives the most votes, whether or not an absolute majority, is elected. The dates of these two elections were set for March 29, and April 26. Counting on no decision in the first election, most of the German parties put candidates in the field. The nominees were as follows: Extreme Nationalists, General Ludendorff; Bavarian People's Party, former Bavarian Premier Held; Nationalists and People's Party, Dr. Karl Jarres; Center, ex-Chancellor Marx; Democrats, Professor Hellpach; Socialists, Otto Braun; Communists, Ernst Thaelmann. It was anticipated that Jarres and Braun would take first and second place in the preliminary voting.

UNITED STATES AND LATIN AMERICA

ISLE OF PINES TO CUBA.—The Isle of Pines Treaty with Cuba, negotiated by John Hay in 1904, was ratified by the United States Senate on March 13, 1925. The treaty relinquishes any United States claim to the island that might be raised under Articles 1 and 2 of the Peace Treaty between the United States and Spain. At the same time the Senate decided to defer action on the Lausanne Treaty with Turkey and the question of becoming a member of the World Court until the regular session of Congress in December.

TACNA-ARICA SETTLEMENT.—On March 9 President Coolidge submitted his decision as arbitrator in the dispute between Chili and Peru over the provinces of Tacna and Arica, taken from Chile by Peru in 1883. The decision provides: (1) that a plebescite shall be held; (2) that the date and rules of the plebiscite shall be determined by a commission of three representing Chili, Peru, and the United States, which must meet within six months from the date of the decision; (3) that those allowed to vote shall be all males over twenty-one born in the provinces or resident two years prior to registration, with the exception of civil and military officials not born in the provinces. The northern boundary of the district in dispute was decided in favor of Peru, and the southern boundary was submitted to a special commission. The decision, though not fully meeting the claims of either party, was more favorably received in Chili than in Peru.

BOOK REVIEWS

THE MERCHANT NAVY. By Archibald Hurd. Longmans, Green and Company, New York. Vol. I, 1921, $7.50. Vol. II, 1924, $7.50.

REVIEWED BY REAR ADMIRAL ALBERT GLEAVES, U. S. NAVY, RET.

Many years ago a navy poet, deploring the scant attention given to the dead sailors of the Civil War, wrote a Decoration Day poem, in which he asks:

> What song will sing, what chant will bless,
> The breeze-blown graves of outer deep?

The sentiment is recalled by the volumes of Mr. Hurd, who has done for the Merchant Navy of Great Britain what Sir Julian Corbett did for the Royal Navy, and he has done it with skill and sympathy.

The two volumes under consideration trace the history of the Mercantile Marine from the earliest times down to the year 1917. He presents the story against a fascinating background woven with the adventures of British seamen in the days of William Rufus, who, we are told, created the Cinque Port fleet, which defeated the French Armada, and in the Elizabethan period when Elizabeth's great sea captains, Drake, Frobisher, Hawkins, Raleigh and others, "burst into the Southern sea," circumnavigated the globe, "planted new lands on the coast of America," destroyed the ships of Medina Sidonia and voyaged to the Orient for the "Discoveries of the Trade for the East Indies."

Drake, whom the Queen knighted and made an admiral in the navy, inherited the traditions of the sea created by the famous laws of Oleron, said to be the oldest collection of modern maritime laws and generally ascribed to Richard I, and he and the other merchant adventurers of that time created traditions which have become the spirit of the merchant service today.

The Merchant Marine is older than the Royal Navy. The latter was first organized by Henry VIII, but was merged with the Merchant Marine, until the defeat of the Spanish Armada when the inadequacy of merchant ships for the line of battle was demonstrated. From that time the two services developed on lines of their own. By the end of the seventeenth century the merchant ship as a fleet unit had practically disappeared. For two hundred years there is little to be told of the merchant service, except of its prosperity in the sea-borne trade of England.

During the Revolutionary and Napoleonic Wars, it fell a prey to French corsairs and privateers. In the period 1793-1815 more than 11,000 British merchant vessels were captured, but, notwithstanding this, the activities of the English ship yards were such that the tonnage at the end of the

war was greater than at the beginning. During this period the convoy system was introduced, the press gang flourished and the morale of the service sank to the lowest ebb.

The convoy was unpopular. Many owners and captains preferred the "daring individual voyages." They disliked the delays in assembling, and in sailing, and the simultaneous arrival of many ships in port, which choked the markets and reduced prices. It is interesting to note that sometimes the convoys were composed of as many as 600 vessels, and on one occasion Lord Saumarez in the *Victory* convoyed 1,000 sail; it is true that they were small vessels, the average tonnage being about 150 tons or less.

The press gang was the terror of the merchant sailor, afloat as well as ashore. At sea he was liable to be taken out of his ship to fill vacancies in a man-of-war; on shore he was kidnapped on the streets, or dragged out of his own home; often he was never heard of again. Strange as it may seem, this system of recruiting for the navy was sanctioned by custom if not by law. In 1793 the Admiralty employed in the impressment service, three flag officers, twenty-nine captains, fifty-four lieutenants and 4,000 men. It was not abolished until the late '30's, and then against the opposition of the reactionaries who were unwilling to agree to any weakening of their power.

In the middle of the nineteenth century public attention was drawn to the living conditions in the merchant service and laws were passed to ameliorate the life of the merchant sailor. The ignorance and brutality of captains, drunkenness of officers and men, unseaworthy and overloaded ships had been the main cause of marine disasters until thirty years after Trafalgar. Then came a period of reform for which the introduction of the steam engine was largely responsible. New navigation laws, the transition from wood to iron and then to steel in ship building; watertight subdivision; the Plimsoll mark and changes in insurance produced an era of great prosperity for British shipping and British seamen which continued uninterruptedly until the summer of 1914.

On June 30, 1914, the British Merchant Marine consisted of 8,236 vessels of about 12,000,000 tons, which was forty-seven per cent of the world's shipping. These ships were scattered over 80,000 miles of trade routes. It was therefore obvious from the beginning that the protection that could be given by the navy would be restricted to certain points, focal areas, for instance, of the steamship lanes. Ten years before the war, the question of the protection of the Merchant Marine by the Admiralty had been under consideration. In 1903 a commission was appointed and sat many months. Volumes of evidence were adduced and the following conclusions were arrived at:

1. Concentration of naval forces was the more effective protection.
2. It would be injurious to lay up liners or tramps.
3. Convoys were *not* favored. (In the initial stages.)
4 There was no reason to fear interruption of supplies.

The merchant service did not entertain the thought that under any circumstances they would be brought into the war. The generally accepted principles of international law, their trust in the *camaraderie* of the sea, and their sense of security from their own defenselessness encouraged merchant seamen to hope that when war came it would bear less hardly upon them than past conflicts had done.

To be sure, the question of floating mines was a serious one, although at the plenary meeting of the Hague Conference in 1908 von Bieberstein vociferously disclaimed Germany's intention to demand unlimited liberty in the use of mines. "The officers of the German Navy," he said, "will always fulfil in the strictest fashion the duties which emanate from the unwritten law of humanity and civilization. I cannot admit that there is a government or country which is superior in these sentiments to that which I have the honor to represent."

At the Second Hague Conference, Germany had opposed the British proposal, supported by the United States and Japan, which would have allowed the arming of merchant ships only in the national ports or territorial waters of the converting power. When it was discovered that one of the North German Lloyd vessels was provided with gun mountings, it was suspected that Germany might arm her merchantmen at sea, "and fresh impetus was given to arming British merchant ships," so at the beginning of the war thirty-nine British merchant vessels had each been provided with two 4.7 guns. Many an enemy submarine would have been destroyed had even a moderate number of ships been similarly equipped.

Germany had about twenty vessels in her own ports capable of conversion, about as many more in North Atlantic ports, and another score in various ports of the world.

But the main reliance of British seamen was upon the increased regard the nations had paid for many years to international usage, and "the anxiety which had been expressed by them to make their acts conform to the unwritten code, to the dictates of humanity."

That so many of Germany's largest ships were in foreign ports and unarmed when war broke out, is evidence that she did not expect Great Britain to intervene, or that the navy would be mobilized so quickly.

On June 22 (1914) an indication of what the British seamen might expect was disclosed in an order issued by the German Naval Staff. It said in part:

> The exercise of the right of stoppage, search and capture, as well as any attack made by an armed merchantman against a German or neutral vessel, is piracy. The crews are to be dealt with under the ordinance relating to extraordinary martial law.
>
> If an armed enemy merchant vessel offers armed resistance against measures taken under the law of prize, such resistance is to be overcome with all means available, etc. The crews are to be considered prisoners of war and the passengers in case of resistance might be proceeded against under extraordinary martial law.

This order, says the author, explains the German policy of frightfulness at sea, and is an essential element in the due application of the danger to which the merchant seamen were exposed.

Then the war came, and the greater part of Mr. Hurd's history is given to the recital of thrilling stories of dogged resistance in the face of unparalleled dangers by the merchant seamen, "non-combatants and unpledged to the state." To them as much as to our own men aptly apply the words of the inscription on the memorial tablet in the Seamen's Institute in New York City:

> In remembrance of the officers and men of the Merchant Marine who in the World War of 1914-18 without fervor of battle or privilege of fame went down to the sea and endured all things.
> They made victory possible and were great without glory.

It is beyond the scope of this article to follow the narrative of disaster and death which has been compiled from official sources. With a few exceptions such as the sailor-like conduct of Captain Ludecke of the *Dresden*, the captain of the *Karlsruhe*, and the submarine commander Hans Rose at the sinking of the *Jacob Jones*, it is a sordid story, the mere recital of which is the severest arraignment of people who fired upon women and children in open boats, abandoned men struggling for their lives in the storm-swept icy waters of the Atlantic, and who laughed and jeered at the drowning of their fellow beings. As Colonel Roosevelt said of the sinking of the *Lusitania*, "it was not merely piracy, but piracy on a vaster scale of murder than any old-time pirate ever practiced."

The many stories of the wholesale sinking of merchant vessels differ only in the degree of their disregard of all the laws of Poseidon, which the brotherhood of the sea have held sacred in all ages, since those scriptural sailors "called to the brethren which were in another vessel to come unto their help, *and they came.*" Each one is an epic of war by the sea, and should never be forgotten.

The merchant service, however, was employed otherwise than in forlorn and desperate encounters with submarines.

The liners and other big ships were engaged in transporting troops, patrolling and blockading. As a rule they were commanded by naval officers, but as far as possible retained their own captain, officers and crew. Great numbers of fishermen were brought into the service and were actively and efficiently employed in the trawlers and drifters largely officered from the Naval Reserves. It was Lord Charles Beresford who, in 1907, suggested the use of trawlers in war time. Experiments with them were successful, and six were bought and fitted out. Naval officers on the retired and emergency lists were trained in their use, and the Trawler Section of the Royal Naval Reserve was organized in 1910.

The achievement of the Merchant Marine in transporting troops brought from the dominions, and across channel was accomplished under the protection of the navy, and the success of the operation reflects credit on both services. Their convoys were operated on the general lines familiar to us.

The British gave us the benefit of their experience, and we took more than one leaf out of their book. There was, however, a great difference. We had to build up our system from almost nothing, while from the beginning they had a large merchant service to draw from. It was, moreover, a new experience for us, whereas England had the experience of the Crimean, Egyptian and South African wars, under totally different conditions it is true, but nevertheless helpful in organizing. The author truly says, "The overseas transport of large military forces calls for closest cooperation between naval and military departments and demands perhaps a higher degree of technical efficiency in all the elements concerned than any other operation of war."

The two volumes are well illustrated and the text is supplemented by numerous charts. It is hoped that someone will do for the sailors of the American Merchant Marine, what Mr. Hurd has accomplished for his countrymen who served so meritoriously under the Red Ensign.

NEW ALTITUDE AND AZIMUTH TABLES—By Hydrographic Department, Tokyo, Japan, 1924.

REVIEWED BY COMMANDER BENJAMIN DUTTON, U. S. NAVY

This is another addition to the growing list of publications that offer methods of determining lines of position without recourse to logarithms. It contains two methods, with the necessary tables for use with them. In the first method the solution is made from an assumed position, so selected as to avoid interpolation in the tables. The tables are conveniently arranged, and easy to use. Three book openings are required for the calculation of the altitude and three for the azimuth. The arithmetical work involved is merely the addition of two five-place numbers and two three-place decimals, plus the combination of the declination with a function selected from the tables. The tables give a range in latitude and declination from 65°N, to 65°S.

In the second method the solution is made from the estimated position. Seven book openings are necessary, and six selections must be made for the solution for the altitude and four for the azimuth. The arithmetical work seems only slightly less than the solution by logarithms.

In addition to the explanation of the above methods and necessary tables incidental thereto the book contains all the other tables usually required by the navigator, such as traverse tables, corrections to observed altitudes, meridianal parts, etc., and notably a very compact star identification table. All of this is presented in good type in a book of 152 pages measuring 6 x 9¾ inches, bound in flexible covers. It is in extremely convenient form for navigators who must work in restricted places.

SECRETARY'S NOTES

Membership New members joining since last report:

Lofberg, G. B., Midn., U.S.N.
Conrad, R. D., Midn., U.S.N.
Belt, Haller
Metcalf, J. R.
Foyt, R. C., Lieut., U.S.N.R.F.
Briggs, G. K., Lieut., U.S.N.R.F.
Buenano, P. A., Captain, P.N.

Book Department The attention of all members is invited to the Institute's book department, whereby members can obtain practically any book from the Institute as cheaply as from the publishers, and in some cases below pubishers' costs. Members are invited to make use of this service.

New Books Attention is invited to the new book entitled "Naval Aviation," compiled for the use of the midshipmen in the Department of Seamanship, U. S. Naval Academy, by Lieutenant W. W. Warlick, U. S. N. This book has received very favorable notice in the Eastern press, and, being written in non-technical language, gives a clear, concise, yet comprehensive survey of naval aviation and its problems in the fleet. It deals with this subject in such a way as to be of the utmost interest to every officer in the service, especially to the younger officers who may desire to get firmly fixed in their minds once and for all just what part aviation plays in the Navy today, and the lines along which it will most probably expand in the near future. It is also of use to officers preparing for examinations for promotion. The book will also prove of interest to reserve officers and those civilians interested in aviation and the Navy.

Other books recently published and of interest to the officers of the Navy are the newly revised editions of "Naval Leadership," price $1.50, and "Notes on Naval Communications," price $1.30. The latter gives a clear and workable understanding of the fundamental principles underlying our present day communications system. It will also be helpful to officers preparing for examination.

Articles The Institute desires articles of interest to all branches of the service, including the reserve force. Non-members as well as members may submit articles, and authors receive due compensation for articles published. **Compact,** well digested articles are more likely to be accepted for early publication. In accepting articles for publication, the Institute

reserves the right to have such articles revised or rearranged, where necessary, in order to bring them up to the required standard of articles published in the PROCEEDINGS—the cost, if any, to be deducted from the compensation due the author.

Reprints of Articles Twenty copies of reprints are furnished authors free of charge. Additional copies to the number desired will be furnished at author's expense, provided request is made before going to press.

Discussions Discussion of articles published in the PROCEEDINGS is cordially invited. Discussions accepted for publication are paid for at approximately one-half the rate for original articles.

Book Reviews As soon as practicable after the publication of books on subjects of professional interest, the Institute aims to publish authoritative reviews of them.

Address of Members In the past, many errors have resulted from the habit of changing an officer's address as soon as his transfer orders are published in the papers. No change will be made in the future except upon receipt of notification by the member concerned. Reliance upon the former method may, in extreme cases, mean a delay of almost four months. To insure the prompt delivery of the PROCEEDINGS and other communications from the U. S. Naval Institute, it is essential that members and subscribers *notify the Secretary-Treasurer without delay of every change of address.* No responsibility can be accepted for failure to receive the PROCEEDINGS, where members fail to comply with this rule. Changes of address should reach the Institute by the 23d of the month, to be effective for the issue of the PROCEEDINGS of the following month.

Coupons for Applications For the convenience of members making application for membership or for subscription, or informing the Institute of changes of address, a number of blank forms will be found elsewhere in this issue. It is hoped that members will take full advantage of these in order to reduce clerical work of all concerned.

H. A. BALDRIDGE,
Captain, U. S. Navy, Secretary-Treasurer.